



Issued Date: Sep. 25, 2007

Model No.: V562D1-L02

Approval

## TFT LCD Approval Specification

### MODEL NO.: V562D1 - L02

Customer: \_\_\_\_\_

Approved by: \_\_\_\_\_

Note:

|             |                  |  |
|-------------|------------------|--|
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## - CONTENTS -

|  |    |
|--|----|
| REVISION HISTORY                                     | 3  |
| 1. GENERAL DESCRIPTION                               | 4  |
| 1.1 OVERVIEW   |    |
| 1.2 FEATURES   |    |
| 1.3 APPLICATION                                      |    |
| 1.4 GENERAL SPECIFICATIONS                           |    |
| 1.5 MECHANICAL SPECIFICATIONS                        |    |
| 2. ABSOLUTE MAXIMUM RATING                           | 6  |
| 2.1 ABSOLUTE RATINGS OF ENVIRONMENT                  |    |
| 2.2 RATINGS OF IMAGE STICKING                        |    |
| 3. ELECTRICAL MAXIMUM RATINGS                        | 8  |
| 3.1 TFT LCD MODULE                                   |    |
| 3.2 BACKLIGHT UNIT                                   |    |
| 4. ELECTRICAL CHARACTERISTICS                        | 9  |
| 4.1 TFT LCD MODULE                                   |    |
| 4.2 BACKLIGHT UNIT                                   |    |
| 4.2.1 CCFL CHARACTERISTICS                           |    |
| 4.2.2 INVERTER CHARACTERISTICS                       |    |
| 4.2.3 INVERTER INTERFACE CHARACTERISTIC              |    |
| 5. BLOCK DIAGRAM                                     | 16 |
| 5.1 TFT LCD MODULE                                   |    |
| 6. LCD INPUT TERMINAL PIN ASSIGNMENT                 | 17 |
| 6.1 TFT LCD MODULE DVI INPUT                         |    |
| 6.2 TFT LCD MODULE POWER INPUT                       |    |
| 6.3 BACKLIGHT UNIT                                   |    |
| 6.4 INVERTER UNIT                                    |    |
| 6.5 BLOCK DIAGRAM OF IMAGE SIGNAL                    |    |
| 6.6 DVI SIGNAL LIST                                  |    |
| 6.7 DVI LINK TIMING REQUIREMENTS                     |    |
| 7. INTERFACE TIMING                                  | 24 |
| 7.1 INPUT SIGNAL TIMING SPECIFICATIONS               |    |
| 7.2 EXTENDED DISPLAY IDENTIFICATION DATA (EDID)      |    |
| 7.3 EXTENDED DISPLAY IDENTIFICATION DATA (EDID) CODE |    |
| 7.4 POWER ON/OFF SEQUENCE                            |    |
| 8. OPTICAL CHARACTERISTICS                           | 28 |
| 8.1 TEST CONDITIONS                                  |    |
| 8.2 OPTICAL SPECIFICATIONS                           |    |
| 9. PRECAUTIONS                                       | 32 |
| 9.1 ASSEMBLY AND HANDLING PRECAUTIONS                |    |
| 9.2 SAFETY PRECAUTIONS                               |    |
| 9.3 SAFETY STANDARDS                                 |    |
| 10. DEFINITION OF LABELS                             | 33 |
| 10.1 CMO MODULE LABEL                                |    |
| 11. PACKAGE  | 34 |



## 11.1 PACKING SPECIFICATIONS

## 11.2 PACKING METHOD

## 12. MECHANICAL CHARACTERISTICS

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36REVISION HISTORY

| Version | Date       | Page (New) | Section | Description  |
|---------|------------|------------|---------|--|
| Ver 2.0 | Mar. 9.'07 | All        | All     | Approval Specification is first issued.                                    |
| Ver 2.1 | Jul.25.'07 | 5          | 1.5     | Modify the value of Horizontal(H) and Vertical(V).                         |
|         |            | 14         | 4.2.3   | Add Note (4)、(5).  |
|         |            | 16         | 5.1     | Modify CN1:S14B-PH-SM4-TB(D)(LF).<br>Modify CN2:S12B-PH-SM4-TB(D)(LF).     |
|         |            | 19         | 6.4     | Modify CN1:S14B-PH-SM4-TB(D)(LF).<br>Modify CN2:S12B-PH-SM4-TB(D)(LF).     |
|         |            | 28         | 8.2     | Modify Center Luminance of White to<br>Typ.=450 nits and Min.=400 nits.    |
|         |            | 36         | 12      | Add screw hole section drawing.  |
| Ver 2.2 | Sep.25.'07 | 6          | 2.1     | Modify Max. of Operating Ambient Temperature to 45 °C.                     |
|         |            | 6          | 2.1     | Modify Note (2)  |
|         |            |            |         | Surface temperature of display area should be less than or equal to 70 °C. |
|         |            | 11         | 4.2.1   | Modify the value of Lamp Current.  |
|         |            | 11         | 4.2.2   | Modify the value of Power Consumption and Power Supply Current.            |
|         |            | 12         | 4.2.2   | Modify Note (4) $I_L = 5.5 \sim 6.5 \text{mA rms}$ .                       |
|         |            | 12         | 4.2.2   | Modify Note (6) average lamp current 6.3mA.                                |
|         |            | 28         | 8.1     | Modify the value of Lamp Current.  |
|         |            | 28         | 8.2     | Modify Cross Talk from 4% to 2%.   |
|         |            | 30         | 8.2     | Modify Note (5).   |
|         |            | 31         | 8.2     | Modify Note (7).   |



## 1. GENERAL DESCRIPTION

### 1.1 OVERVIEW

V562D1-L02 is a 56" Thin-Film-Transistor Liquid-Crystal (TFT-LCD) module with one 32-CCFL backlight unit and 4 ports Single-DVI utilization. This module supports 3840 x 2160 Quad Full High Definition (QFHD) TV format and can display 16.7M colors (8-bit). The inverter module for backlight is also built-in.

### 1.2 FEATURES

- Ultra Wide Viewing Angle (176(H)/ 176(V) for CR>30)
- High Brightness (450 nits)
- High Contrast Ratio (1200:1)
- Ultra Fast Response Time (Gray to gray average 6.5 ms)
- High Color Saturation (NTSC 75%)
- QFHD (3840 x 2160 pixels) Resolution
- 4 Ports Single-DVI (Digital Visual Interface)
- RoHS Compliance

### 1.3 APPLICATION

- Luxurious Living Room TVs
- Public Display
- Home Theater
- Satellite Communication
- Medical Analyses/ Instruction
- Security and Monitoring
- Industrial Design
- 3D Display
- Digital Museum
- Multi-Media Display

### 1.4 GENERAL SPECIFICATIONS

| Item                   | Specification  | Unit  | Note |
|------------------------|--|-------|------|
| Active Area            | 1244.16 (H) x 699.84 (V) (56.2" diagonal)                | mm    |      |
| Bezel Opening Area     | 1252.1 (H) x 707.8 (V)                                   | mm    |      |
| Driver Element         | a-si TFT active matrix                                   | -     | -    |
| Pixel Number           | 3840x R.G.B. x 2160                                      | pixel | -    |
| Pixel Pitch(Sub Pixel) | 0.108 (H) x 0.324 (V)                                    | mm    | -    |
| Pixel Arrangement      | RGB vertical stripe                                      | -     | -    |
| Display Colors         | 16.7M  | color | -    |
| Display Operation Mode | Transmissive mode / Normally black                       | -     | -    |
| Surface Treatment      | Hard coating 3H<br>Low reflection coating< 2% reflection | -     | (1)  |

Note (1) The specifications of the surface treatment are temporarily for this phase. CMO reserves the rights to change this feature.



Issued Date: Sep. 25, 2007

Model No.: V562D1-L02

**Approval**

### 1.5 MECHANICAL SPECIFICATIONS

| Item        |               | Min.  | Typ.   | Max.   | Unit | Note              |
|-------------|---------------|-------|--------|--------|------|-------------------|
| Module Size | Horizontal(H) | 1309  | 1309.5 | 1310.2 | mm   |                   |
|             | Vertical(V)   | 766.5 | 767    | 767.7  | mm   |                   |
|             | Depth(D)      | 57.2  | 58.5   | 59.8   | mm   | To PCB cover      |
|             | Depth(D)      | 61.9  | 63.2   | 64.5   | mm   | To inverter cover |
| Weight      |               | 23000 | 23500  | 24000  | g    |                   |



## 2. ABSOLUTE MAXIMUM RATING

### 2.1 ABSOLUTE RATINGS OF ENVIRONMENT

| Item                          | Symbol    | Value               |                                | Unit        | Note                             |
|-------------------------------|-----------|---------------------|--------------------------------|-------------|----------------------------------|
|                               |           | Min.                | Max.                           |             |                                  |
| Storage Temperature           | $T_{ST}$  | -20                 | +55                            | °C          | (1)                              |
| Operating Ambient Temperature | $T_{OP}$  | 0                   | 45                             | °C          | (1), (2)                         |
| Shock (Non-Operating)         | $S_{NOP}$ | X, Y axis<br>Z axis | -<br>-<br>-<br>30<br>30<br>1.0 | G<br>G<br>G | (3), (5)<br>(3), (5)<br>(4), (5) |
| Vibration (Non-Operating)     | $V_{NOP}$ |                     |                                |             |                                  |

Note (1) Temperature and relative humidity range is shown in the figure below.

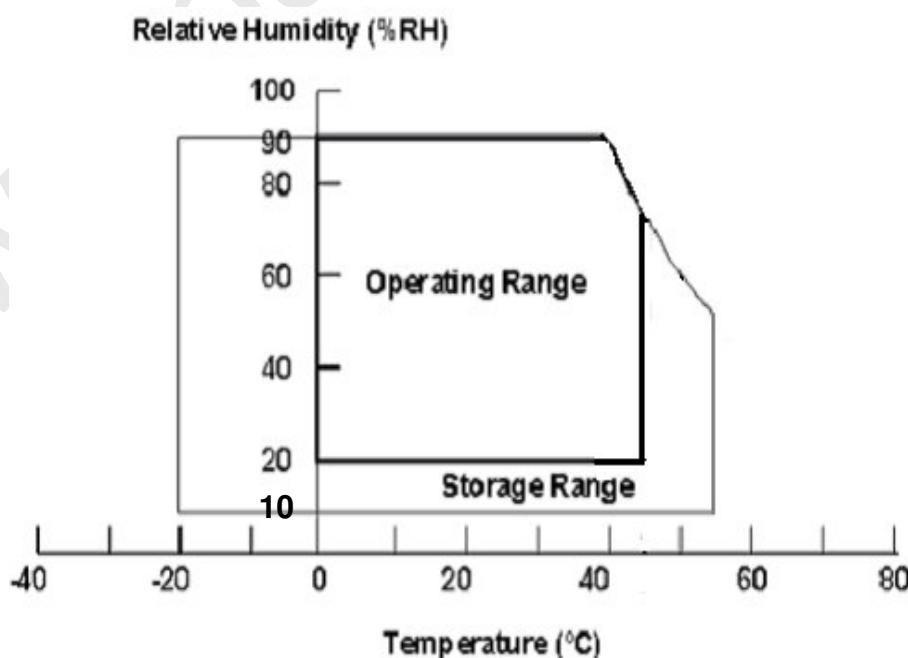
- (a) 90 %RH Max. ( $T_a \leq 40$  °C).
- (b) Wet-bulb temperature should be 39 °C Max. ( $T_a > 40$  °C).
- (c) No condensation.

Note (2) The maximum operating temperature is based on the test condition that the surface temperature of display area is less than or equal to 70 °C with LCD module alone in a temperature controlled chamber. Thermal management should be considered in your product design to prevent the surface temperature of display area from being over 70 °C. The range of operating temperature may degrade in case of improper thermal management in your product design.

Note (3) 11 ms, half sine wave, 1 time for  $\pm X$ ,  $\pm Y$ , and  $\pm Z$ .

Note (4) 10 ~ 200 Hz, 10 min, 1 time each X, Y, Z.

Note (5) At testing Vibration and Shock, the fixture in holding the module has to be hard and rigid enough so that the module would not be twisted or bent by the fixture. The module would not be twisted or bent by the fixture.





Issued Date: Sep. 25, 2007  
Model No.: V562D1-L02

Approval

## 2.2 RATINGS OF IMAGE STICKING

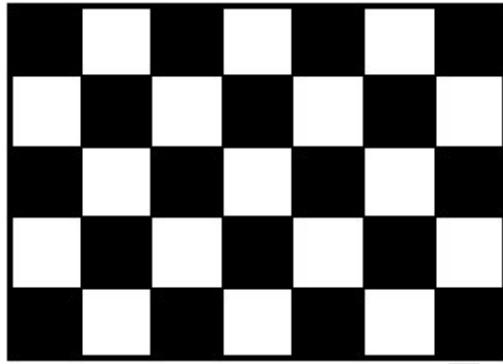
| Item                            | Symbol | Value        | Unit      | Note   |
|---------------------------------|--------|--------------|-----------|--------|
| Room Temperature Image Sticking | RT IS  | Invisibility | 6% ND (%) | (1)(3) |
| High Temperature Image Sticking | HT IS  | Invisibility | 6% ND (%) | (2)(3) |

Note (1) Room temperature image sticking test is at  $25\pm3^\circ\text{C}$  environment and fix the pattern A (checker pattern) for 12 hours.

Note (2) High temperature image sticking test is at  $50\pm3^\circ\text{C}$  environment and fix the pattern A for 12 hours.

Note (3) Inspection condition is at pattern B (128grade) after 5 mins from pattern A.

A. Pattern A (checker pattern)



B. Pattern B (128grade)





### 3. ELECTRICAL MAXIMUM RATINGS

#### 3.1 TFT LCD MODULE

| Item  | Symbol    | Value |      | Unit | Note |
|---|-----------|-------|------|------|------|
|   |           | Min.  | Max. |      |      |
| Power Supply Voltage                            | $V_{CC1}$ | -0.3  | 20   | V    | (2)  |
|   | $V_{CC2}$ | -0.3  | 6    | V    |      |
| DVI Termination Supply Voltage                  | $AV_{CC}$ |       | 4.0  | V    |      |
| DVI Signal Voltage on any pin                   | -         | -0.5  | 4.0  | V    |      |
| DVI Differential Mode Signal Voltage on any pin | -         | -0.5  | 4.0  | V    |      |

Note: (1) Permanent damage to the device may occur if maximum values are exceeded. Function operation should be restricted to the conditions described under normal operating conditions.

(2) The maximum ratings of the DVI are specified in the DVI specification of DDWG.

#### 3.2 BACKLIGHT UNIT

| Item                 | Symbol   | Value |      | Unit      | Note     |
|----------------------|----------|-------|------|-----------|----------|
|                      |          | Min.  | Max. |           |          |
| Lamp Voltage         | $V_W$    | —     | 5000 | $V_{RMS}$ |          |
| Power Supply Voltage | $V_{BL}$ | 0     | 30   | V         | (1)      |
| Control Signal Level | —        | -0.3  | 7    | V         | (2), (3) |

Note (1) Permanent damage to the device may occur if maximum values are exceeded. Function operation should be restricted to the conditions described under normal operating conditions.

Note (2) No moisture condensation or freezing.

Note (3) The control signals include On/Off Control, Internal PWM Control, External PWM Control and Internal/External PWM Selection.

## 4. ELECTRICAL CHARACTERISTICS

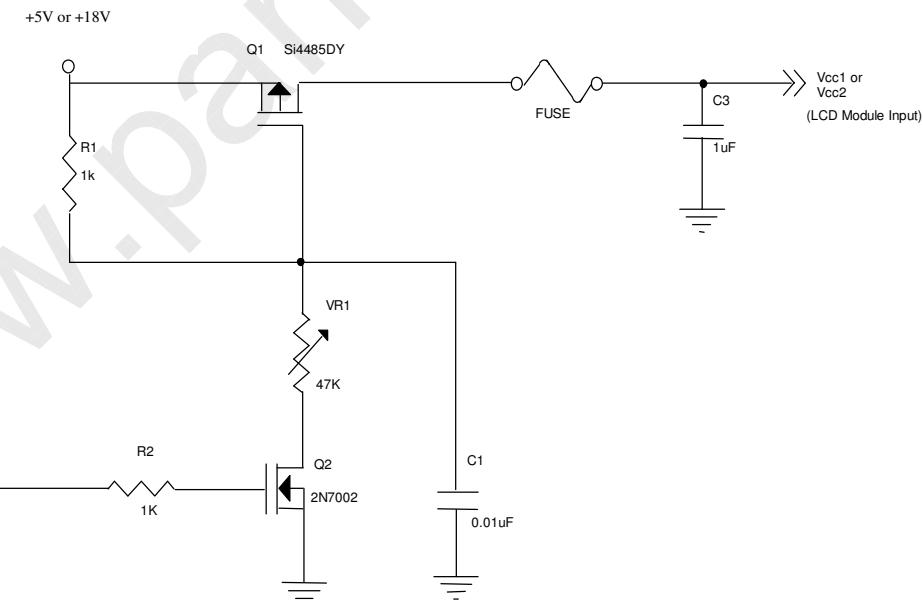
### 4.1 TFT LCD MODULE

Ta = 25 ± 2 °C

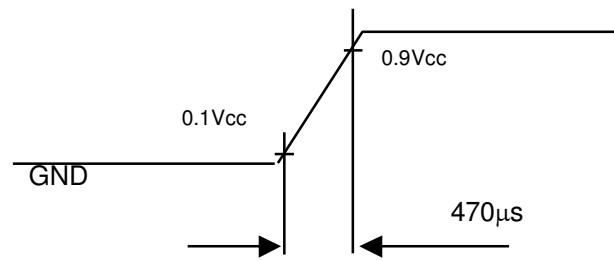
| Parameter                   |   | Symbol             | Value |      |      | Unit | Note    |
|-----------------------------|---|--------------------|-------|------|------|------|---------|
|                             |   |                    | Min.  | Typ. | Max. |      |         |
| Power Supply Voltage        | V <sub>CC1</sub>                                  | V <sub>CC1</sub>   | 17.1  | 18   | 18.9 | V    | (1)     |
|                             | V <sub>CC2</sub>                                  | V <sub>CC2</sub>   | 4.5   | 5    | 5.5  | V    |         |
| Power Supply Ripple Voltage | V <sub>RP1</sub>                                  | V <sub>RP1</sub>   | -     | -    | 400  | mV   |         |
|                             | V <sub>RP2</sub>                                  | V <sub>RP2</sub>   |       |      | 200  | mV   |         |
| Rush Current                | I <sub>RUSH1</sub>                                | I <sub>RUSH1</sub> | -     | -    | 4.5  | A    | (2)     |
|                             | I <sub>RUSH2</sub>                                | I <sub>RUSH2</sub> | -     | -    | 14   | A    |         |
| Power Supply Current        | White   | I <sub>CC1</sub>   | -     | 1.9  | 2.5  | A    | (3)     |
|                             | Black   |                    | -     | 0.7  | -    | A    |         |
|                             | Vertical Stripe                                   |                    | -     | 1.5  | -    | A    |         |
|                             | White   | I <sub>CC2</sub>   | -     | 5.4  | -    | A    |         |
|                             | Black   |                    | -     | 4.9  | -    | A    |         |
|                             | Vertical Stripe                                   |                    | -     | 5.5  | -    | A    |         |
|                             | V-Stripe-2column                                  |                    |       | 7.2  | 9    | A    |         |
| DVI Interface               | Differential Input Voltage Single Ended Amplitude | V                  | 100   | -    | 800  | mV   | (4) (5) |
|                             | Receiver Resistor                                 | R <sub>T</sub>     | 95    | 100  | 105  | ohm  |         |
| CMOS Interface              | Input High Threshold Voltage                      | V <sub>IH</sub>    | 2.7   | -    | 3.3  | V    |         |
|                             | Input Low Threshold Voltage                       | V <sub>IL</sub>    | 0     | -    | 0.7  | V    |         |

Note: (1) The module should be always operated within the above ranges.

(2) Measurement conditions:

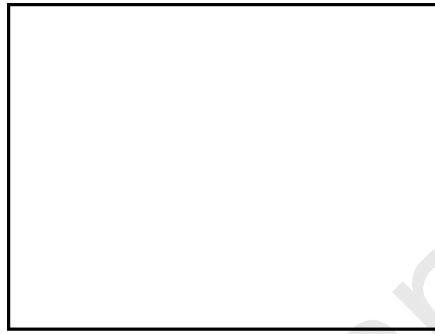


Vcc rising time is at least 470μs



(3) The specified power supply current is under the conditions at  $V_{cc1} = 18$  V,  $V_{cc2} = 5$  V,  $T_a = 25 \pm 2$  °C,  $f_v = 60$  Hz, whereas a power dissipation check pattern below is displayed.

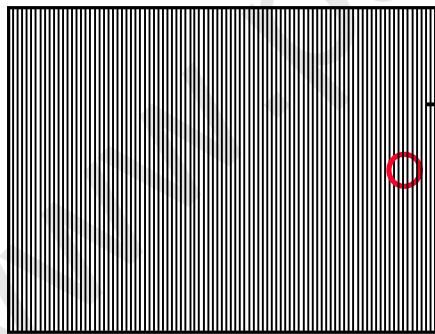
a. White Pattern



b. Black Pattern

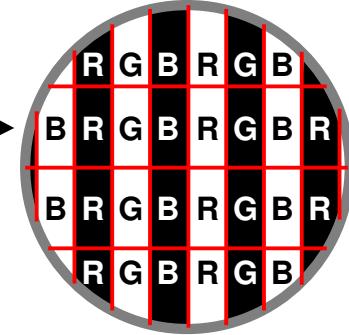


c. Vertical Stripe Pattern



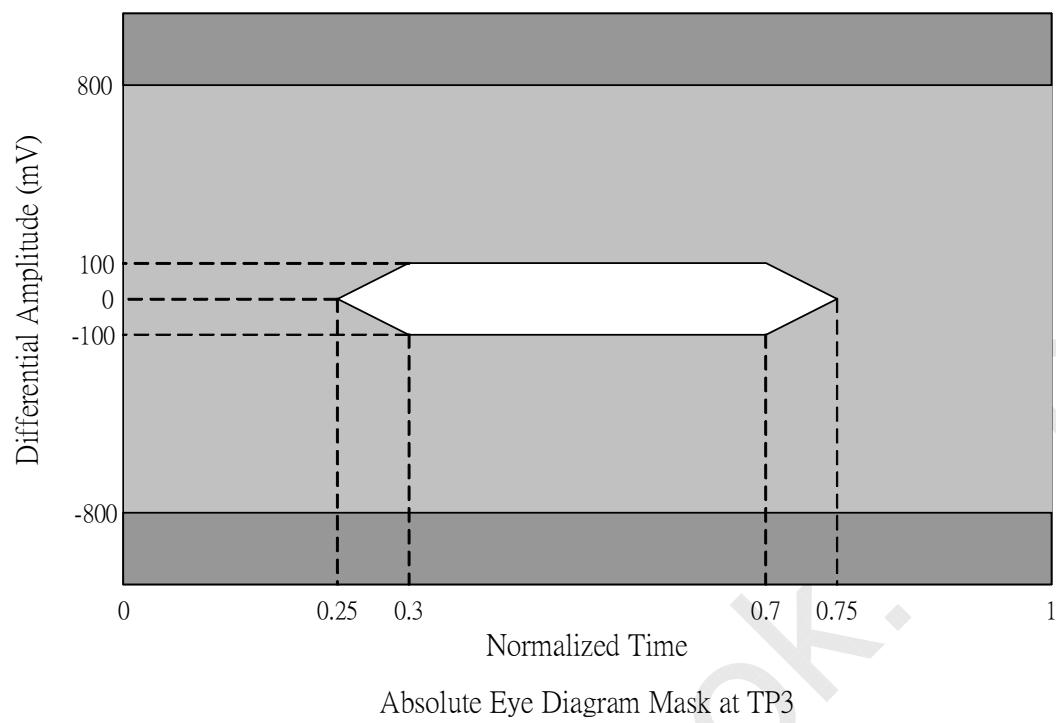
Active Area

Active Area



(4) The electrical characteristics of DVI are specified in the DVI specification of DDWG.

(5) The receiver shall reproduce a test data stream, with pixel error rate  $10^{-9}$ , when presented with input amplitude illustrate by the eye diagram.



## 4.2 BACKLIGHT UNIT

### 4.2.1 CCFL (Cold Cathode Fluorescent Lamp) CHARACTERISTICS (Ta=25±2°C)

| Parameter             | Symbol          | Value |       |      | Unit              | Note                   |
|-----------------------|-----------------|-------|-------|------|-------------------|------------------------|
|                       |                 | Min.  | Typ.  | Max. |                   |                        |
| Lamp Voltage          | V <sub>W</sub>  | -     | 1728  | -    | V <sub>RMS</sub>  | I <sub>L</sub> = 5.7mA |
| Lamp Current          | I <sub>L</sub>  | 5.5   | 6.0   | 6.5  | mA <sub>RMS</sub> | (1)                    |
| Lamp Starting Voltage | V <sub>S</sub>  | -     | -     | 2550 | V <sub>RMS</sub>  | (2), Ta = 0 °C         |
|                       |                 | -     | -     | 2350 | V <sub>RMS</sub>  | (2), Ta = 25 °C        |
| Operating Frequency   | F <sub>o</sub>  | 40    | 60    | 80   | KHz               | (3)                    |
| Lamp Life Time        | L <sub>BL</sub> | -     | 50000 | -    | Hrs               | (4)                    |

### 4.2.2 INVERTER CHARACTERISTICS (Ta=25±2°C)

| Parameter             | Symbol           | Value |       |       | Unit              | Note                        |
|-----------------------|------------------|-------|-------|-------|-------------------|-----------------------------|
|                       |                  | Min.  | Typ.  | Max.  |                   |                             |
| Power Consumption     | P <sub>BL</sub>  | -     | 315   | 330   | W                 | (5), I <sub>L</sub> = 6.0mA |
| Power Supply Voltage  | V <sub>BL</sub>  | 22.8  | 24.0  | 25.2  | V <sub>DC</sub>   |                             |
| Power Supply Current  | I <sub>BL</sub>  | -     | 13.13 | 13.75 | A                 | Non Dimming                 |
| Input Ripple Noise    | -                | -     | -     | 500   | mV <sub>P-P</sub> | V <sub>BL</sub> =22.8V      |
| Oscillating Frequency | F <sub>W</sub>   | 47    | 50    | 53    | kHz               |                             |
| Dimming frequency     | F <sub>B</sub>   | 150   | 160   | 180   | Hz                |                             |
| Minimum Duty Ratio    | D <sub>MIN</sub> | -     | 20    | -     | %                 |                             |

Note (1) Lamp current is measured by utilizing high frequency current meters as shown below:

Note (2) The lamp starting voltage V<sub>S</sub> should be applied to the lamp for more than 1 second after startup.

Otherwise the lamp may not be turned on.



Issued Date: Sep. 25, 2007

Model No.: V562D1-L02

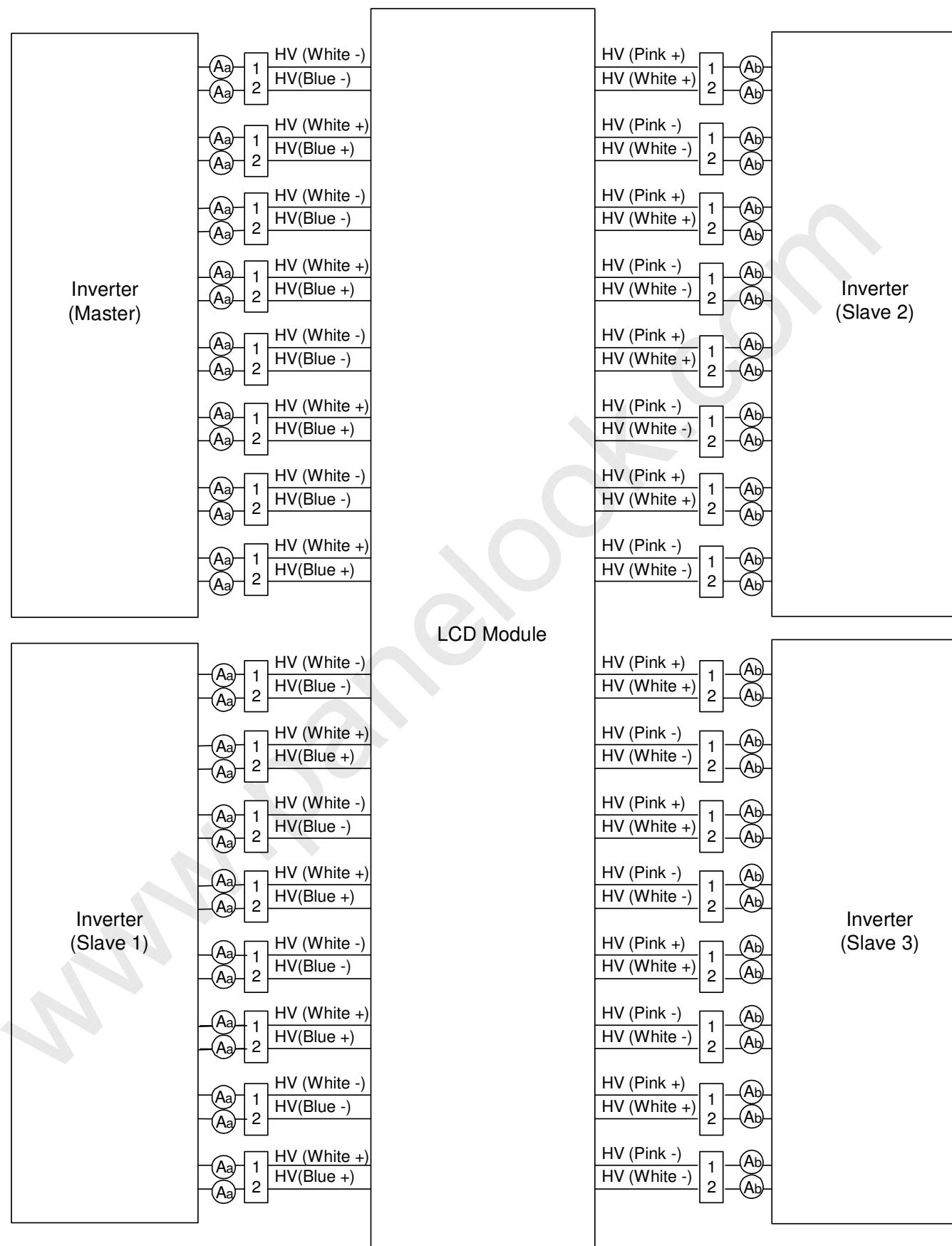
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Note (3) The lamp frequency may produce interference with horizontal synchronous frequency of the display input signals, and it may result in line flow on the display. In order to avoid interference, the lamp frequency should be detached from the horizontal synchronous frequency and its harmonics as far as possible.

Note (4) The life time of a lamp is defined as when the brightness is larger than 50% of its original value and the effective discharge length is longer than 80% of its original length (Effective discharge length is defined as an area that has equal to or more than 70% brightness compared to the brightness at the center point of lamp.) as the time in which it continues to operate under the condition at  $T_a = 25 \pm 2^\circ C$  and  $I_L = 5.5 \sim 6.5 \text{mA rms}$ .

Note (5) The power supply capacity should be higher than the total inverter power consumption  $P_{BL}$ . Since the pulse width modulation (PWM) mode was applied for backlight dimming, the driving current changed as PWM duty on and off. The transient response of power supply should be considered for the changing loading when inverter dimming.

Note (6) The measurement condition of Max. value is based on 56" backlight unit under input voltage 24V, average lamp current 6.3 mA and lighting 30 minutes later.





#### 4.2.3 INVERTER INTERFACE CHARACTERISTICS

| Parameter                            | Symbol            | Test Condition       | Value |      |      | Unit | Note               |
|--------------------------------------|-------------------|----------------------|-------|------|------|------|--------------------|
|                                      |                   |                      | Min.  | Typ. | Max. |      |                    |
| On/Off Control Voltage               | V <sub>BLON</sub> | —                    | 2.0   | —    | 5.0  | V    |                    |
|                                      |                   | —                    | 0     | —    | 0.8  | V    |                    |
| Internal/External PWM Select Voltage | V <sub>SEL</sub>  | —                    | 2.0   | —    | 5.0  | V    |                    |
|                                      |                   | —                    | 0     | —    | 0.8  | V    |                    |
| Internal PWM Control Voltage         | V <sub>IPWM</sub> | V <sub>SEL</sub> = L | 3.15  | 3.3  | 3.45 | V    | Note (5)           |
|                                      |                   |                      | —     | 0    | —    | V    | minimum duty ratio |
| External PWM Control Voltage         | V <sub>EPWM</sub> | V <sub>SEL</sub> = H | 2.0   | —    | 5.0  | V    | duty on            |
|                                      |                   |                      | 0     | —    | 0.8  | V    | duty off           |
| VBL Rising Time                      | Tr1               | —                    | 30    | —    | 50   | ms   |                    |
| VBL Falling Time                     | Tf1               | —                    | 30    | —    | 50   | ms   |                    |
| Control Signal Rising Time           | Tr                | —                    | —     | —    | 100  | ms   |                    |
| Control Signal Falling Time          | Tf                | —                    | —     | —    | 100  | ms   |                    |
| PWM Signal Rising Time               | T <sub>PWMR</sub> | —                    | —     | —    | 50   | us   |                    |
| PWM Signal Falling Time              | T <sub>PWMF</sub> | —                    | —     | —    | 50   | us   |                    |
| Input impedance                      | R <sub>IN</sub>   | —                    | 1     | —    | —    | MΩ   |                    |
| BLON Delay Time                      | T <sub>on</sub>   | —                    | 1     | —    | —    | ms   |                    |
| BLON Off Time                        | T <sub>off</sub>  | —                    | 1     | —    | —    | ms   |                    |

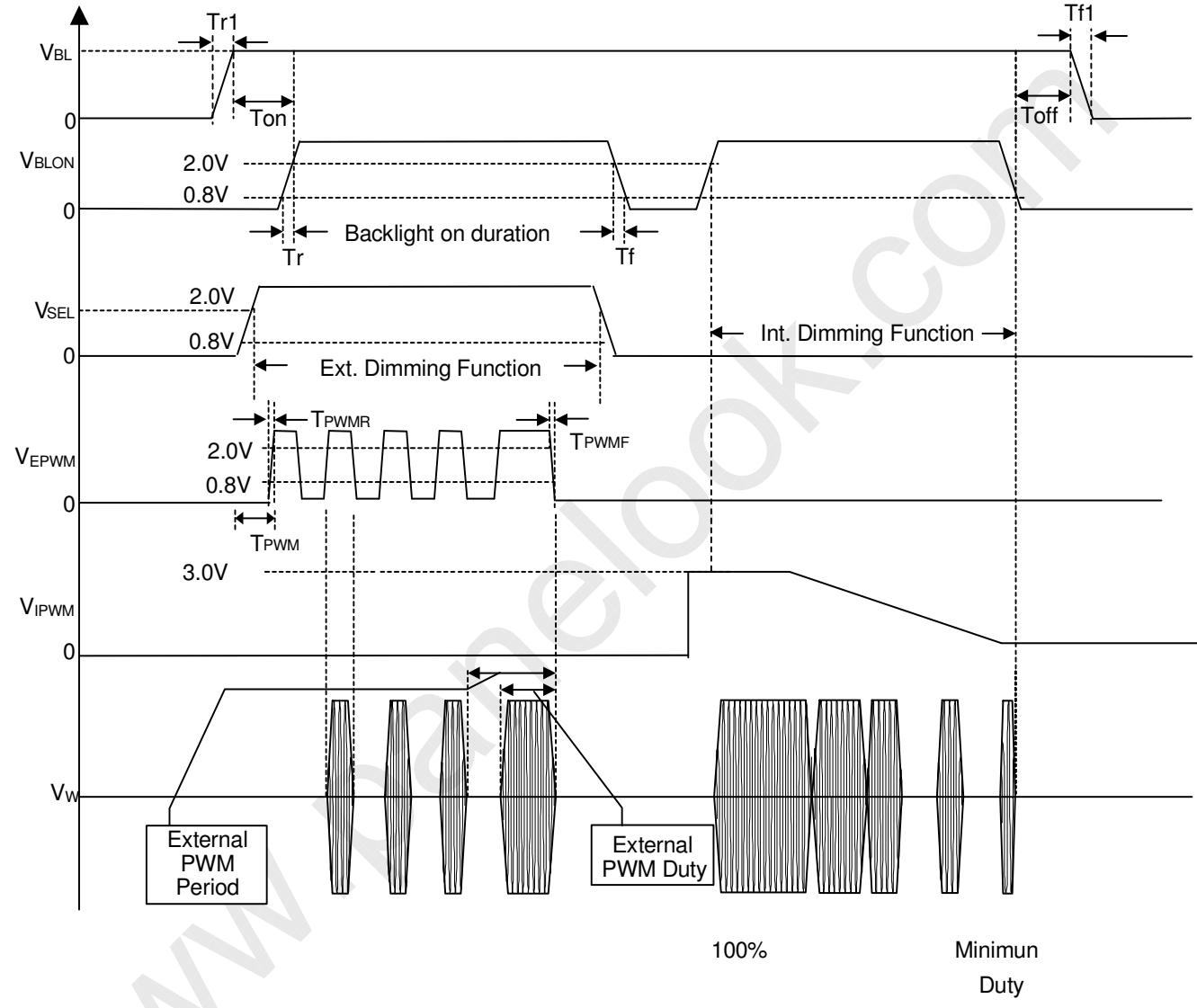
Note (1) The SEL signal should be valid before backlight turns on by BLON signal. It is inhibited to change the internal/external PWM selection (SEL) during backlight turn on period.

Note (2) The power sequence and control signal timing are shown in the following figure.

Note (3) The power sequence and control signal timing must follow the figure below. For a certain reason, the inverter has a possibility to be damaged with wrong power sequence and control signal timing.

Note (4) Abnormal operation may occur if these maximum values of control signal are exceeded.

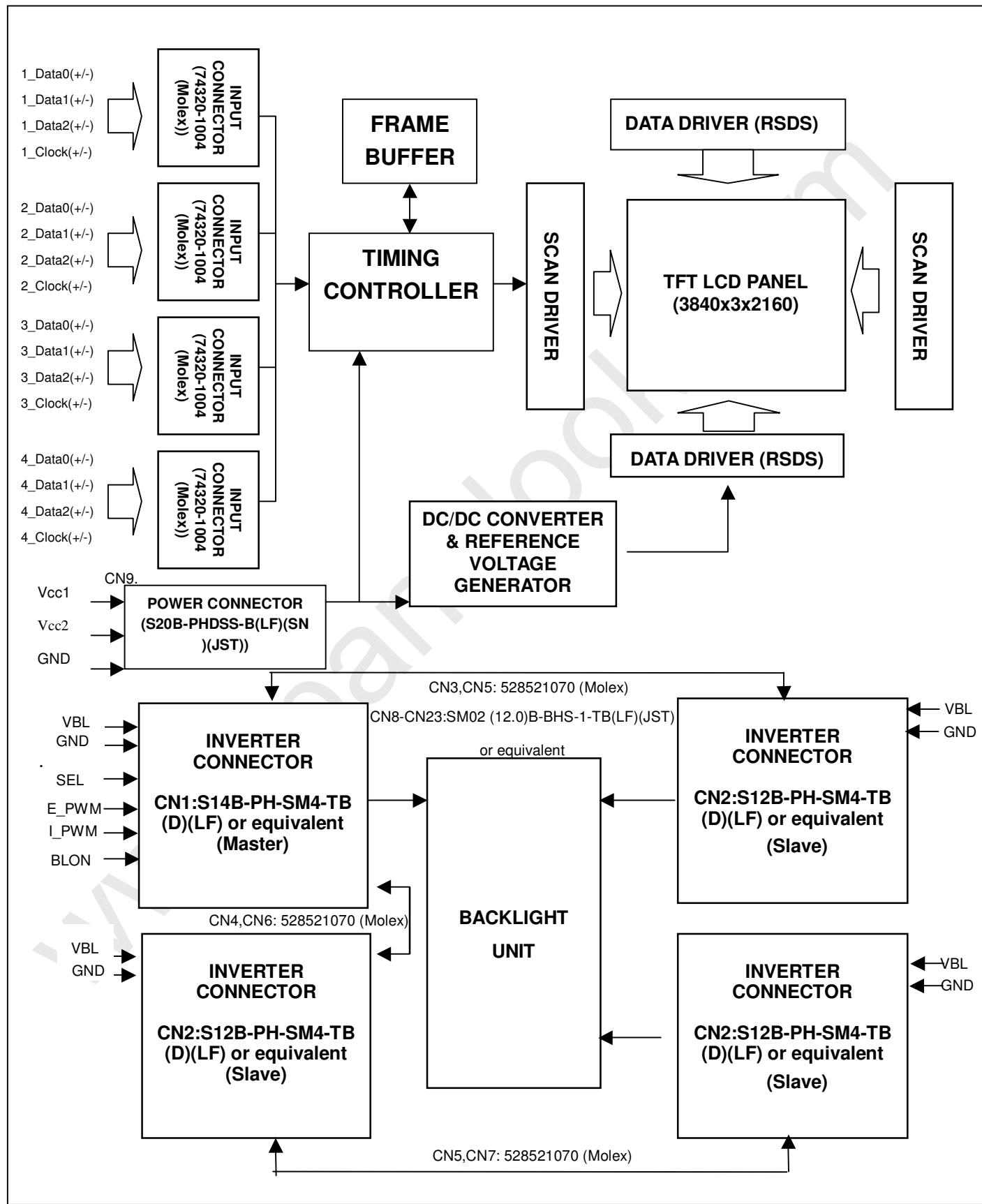
Note (5) The range of V<sub>IPWM</sub> for dimming brightness should be constrained from 0V to 2.85V (i.e., 2.85V is the start dimming point) except the Max. value of V<sub>IPWM</sub> mentioned here is only for the maximum brightness useful. In other words, 2.85V~3.15V is not suggested for using to prevent from possibly abnormal phenomenon.





## 5. BLOCK DIAGRAM

## 5.1 TFT LCD MODULE





## 6. LCD INPUT TERMINAL PIN ASSIGNMENT

### 6.1 TFT LCD MODULE DVI INPUT

#### CN3, CN4, CN5, CN6 Connector Pin Assignment

| Pin | Signal Assignment      | Pin | Signal Assignment      | Pin | Signal Assignment      |
|-----|------------------------|-----|------------------------|-----|------------------------|
| 1   | T.M.D.S Data2-         | 9   | T.M.D.S Data1-         | 17  | T.M.D.S Data0-         |
| 2   | T.M.D.S Data2+         | 10  | T.M.D.S Data1+         | 18  | T.M.D.S Data0+         |
| 3   | T.M.D.S Data2/4 shield | 11  | T.M.D.S Data1/3 shield | 19  | T.M.D.S Data0/5 shield |
| 4   | No Connect             | 12  | No Connect             | 20  | No Connect             |
| 5   | No Connect             | 13  | No Connect             | 21  | No Connect             |
| 6   | DDC Clock              | 14  | +5V Power              | 22  | T.M.D.S Clock shield   |
| 7   | DDC Data               | 15  | Ground(for +5V)        | 23  | T.M.D.S Clock+         |
| 8   | No Connect             | 16  | Hot Plug Detect        | 24  | T.M.D.S Clock-         |
| C1  | No Connect             | C2  | No Connect             | C3  | No Connect             |
| C4  | No Connect             | C5  | No Connect             |     |                        |

Note:(1) CN3, CN4, CN5, CN6 Connector part no.: 74320-1004 (Molex) or equivalent.

(2) The DVI pin assignment is specified in the DVI specification of DDWG.

### 6.2 TFT LCD MODULE POWER INPUT

#### CN9 Connector Pin Assignment

| Pin No. | Symbol | Description                      | Note |
|---------|--------|----------------------------------|------|
| 1       | VIN    | +18.0V power supply              |      |
| 2       | VIN    | +18.0V power supply              |      |
| 3       | V5VC   | +5.0V power supply               |      |
| 4       | V5VC   | +5.0V power supply               |      |
| 5       | V5VC   | +5.0V power supply               |      |
| 6       | NC     | Not connection                   |      |
| 7       | V5VC   | +5.0V power supply               |      |
| 8       | NC     | Not connection                   |      |
| 9       | V5VC   | +5.0V power supply               |      |
| 10      | NC     | Not connection                   |      |
| 11      | GND    | Ground                           |      |
| 12      | NC     | Not connection                   |      |
| 13      | GND    | Ground                           |      |
| 14      | NC     | Not connection                   |      |
| 15      | GND    | Ground                           |      |
| 16      | ODSEL  | Overdrive Lookup Table Selection | (3)  |
| 17      | GND    | Ground                           |      |
| 18      | GND    | Ground                           |      |
| 19      | GND    | Ground                           |      |
| 20      | GND    | Ground                           |      |

Note: (1) CN9 connector part no.: S20B-PHDSS-B(LF)(SN), JST(日本壓著端子),德通端子 or equivalent.

(2) CN10 is just only for CMO internal testing.



(3) ODSEL (Overdrive Lookup Table Selection). The overdrive lookup table should be selected in frame accordance to the frame rate to optimize image quality.

| ODSEL | Note  |
|-------|---|
| L     | Lookup table was optimized for 60Hz frame rate. |
| H     | Lookup table was optimized for 50Hz frame rate. |

(4) "L" and "H" operation in (3) could follow "CMOS Interface" in Section 4.1.

### 6.3 BACKLIGHT UNIT

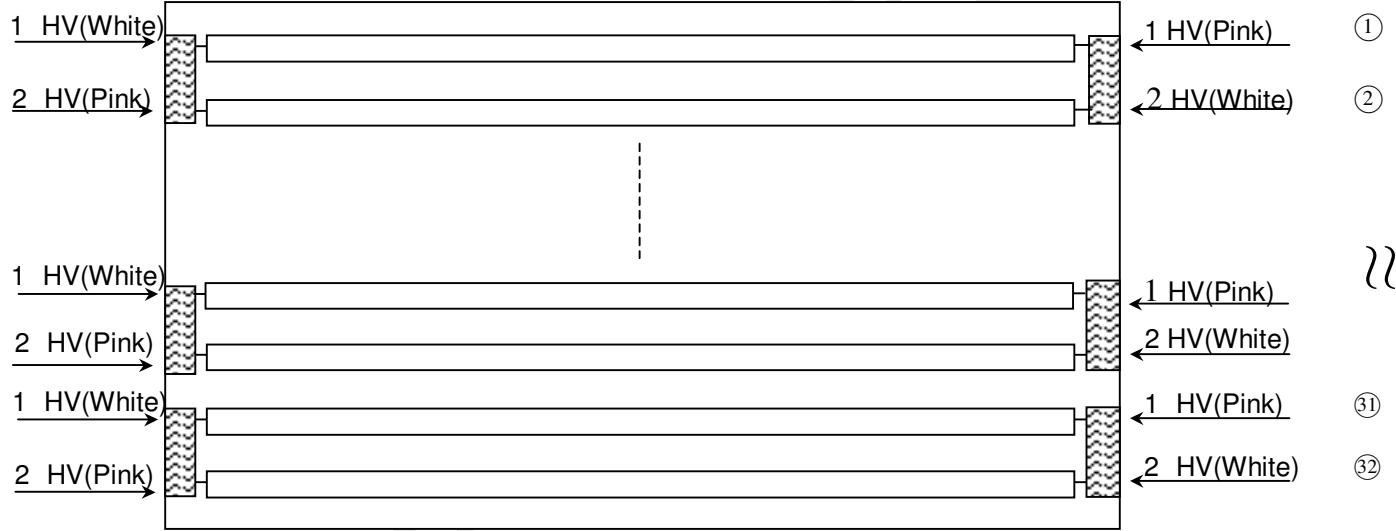
The pin configuration for the housing and the leader wire is shown in the table below.

CN8-CN23: BHR-04VS-1 (JST).

| Pin | Name | Description  | Wire Color |
|-----|------|--------------|------------|
| 1   | HV   | High Voltage | Pink       |
| 2   | HV   | High Voltage | White      |

Note (1) The backlight interface housing for high voltage side is a model BHR-04VS-1, manufactured by JST.

The mating header on inverter part number is SM02(12.0)B-BHS-1-TB(LF).





#### 6.4 INVERTER UNIT

CN1 (Master, Header): S14B-PH-SM4-TB (D)(LF)(JST) or equivalent

| Pin No. | Symbol | Description   |
|---------|--------|---|
| 1       | VBL    | +24V <sub>DC</sub> power input  |
| 2       |        |   |
| 3       |        |   |
| 4       |        |   |
| 5       |        |   |
| 6       | GND    | GND   |
| 7       |        |   |
| 8       |        |   |
| 9       |        |   |
| 10      |        |   |
| 11      | SEL    | Internal/external PWM selection<br>High : external dimming<br>Low : internal dimming                            |
| 12      | E_PWM  | External PWM control signal<br>E_PWM should be connected to ground when internal PWM was selected (SEL = Low).  |
| 13      | I_PWM  | Internal PWM Control Signal<br>I_PWM should be connected to ground when external PWM was selected (SEL = High). |
| 14      | BLON   | Backlight on/off control  |

CN2 (Slave, Header): S12B-PH-SM4-TB (D)(LF)(JST) or equivalent

| Pin No. | Symbol | Description                    |
|---------|--------|--------------------------------|
| 1       | VBL    | +24V <sub>DC</sub> power input |
| 2       |        |                                |
| 3       |        |                                |
| 4       |        |                                |
| 5       |        |                                |
| 6       | GND    | GND                            |
| 7       |        |                                |
| 8       |        |                                |
| 9       |        |                                |
| 10      |        |                                |
| 11      | NC     | NC                             |
| 12      | NC     | NC                             |

CN8-CN15 (Master, Header), CN16-CN23 (Slave, Header): SM02 (12.0) B-BHS-1-TB (LF)(JST) or equivalent

| Pin No. | Symbol   | Description       |
|---------|----------|-------------------|
| 1       | CCFL HOT | CCFL high voltage |
| 2       | CCFL HOT | CCFL high voltage |



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Model No.: V562D1-L02

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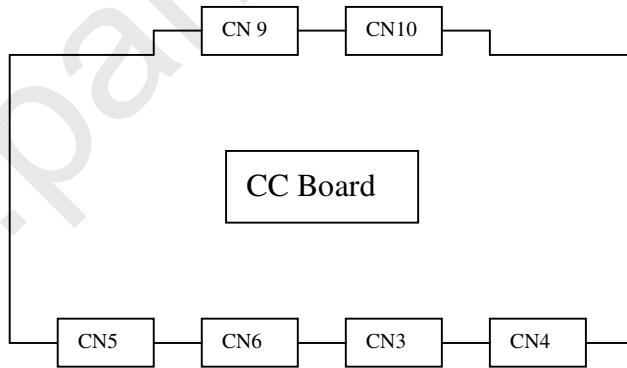
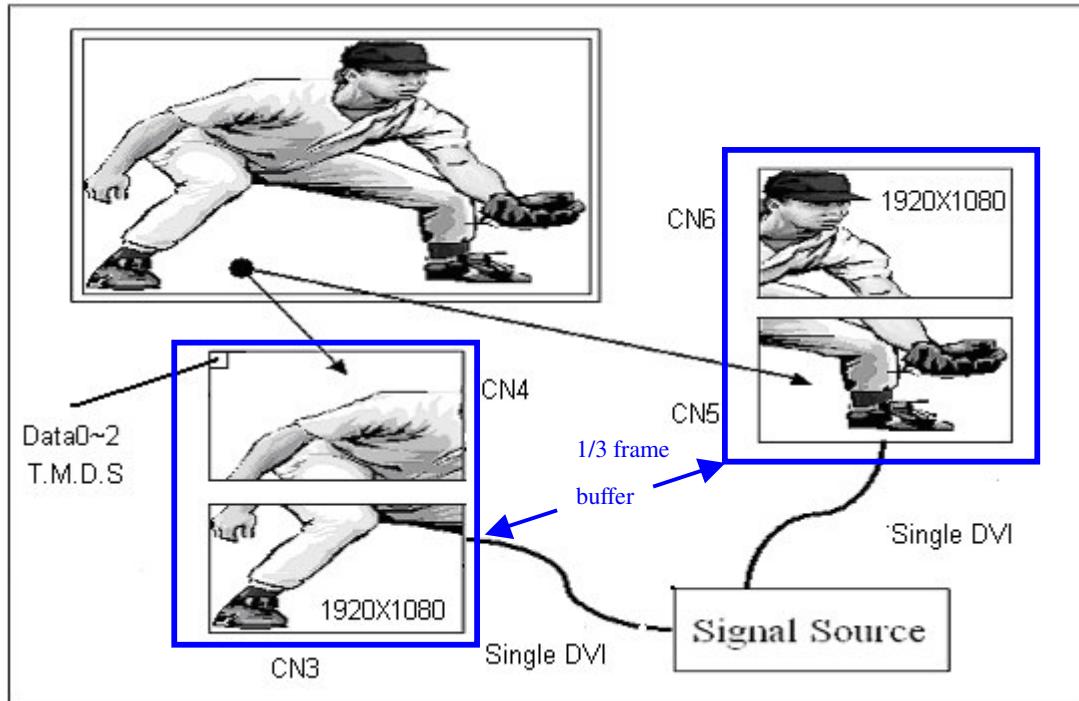
CN3-CN4 (Master, Header), CN5-CN7 (Slave, Header): 528521070 (Molex)

| Pin No. | Symbol            | Description    |
|---------|-------------------|----------------|
| 1       | Control<br>Signal | Board to Board |
| 2       |                   | Board to Board |
| 3       |                   | Board to Board |
| 4       |                   | Board to Board |
| 5       |                   | Board to Board |
| 6       |                   | Board to Board |
| 7       |                   | Board to Board |
| 8       |                   | Board to Board |
| 9       |                   | Board to Board |
| 10      |                   | Board to Board |

Note (1) Floating of any control signal is not allowed.

## 6.5 BLOCK DIAGRAM OF IMAGE SIGNAL

The video picture (3840x2160) should be divided into four parts: the left up side (1920x1080), the left down side (1920x1080), the right up side(1920x1080) and the right down side(1920x1080). Signals of these four parts should be delivered into the module individually through each single-DVI. And the protocol of DVI is specified in the DVI specification of DDWG.



Note:

- (1) It must be "synchronous" mutually between signals from CN3 and CN4.
- (2) It must be "synchronous" mutually between signals from CN5 and CN6.
- (3) It exists 1/3 frame buffer (i.e. buffer =1/3 x 1920 x1080 pixels) between (CN3/CN4) and (CN5/CN6)
- (4) Signals of CN4 and CN6 must always be delivered to keep all of the power that's necessary turned on normally during the operation.
- (5) "Synchronous" written in (1) and (2) is defined as a time difference smaller than 7 CLKs.



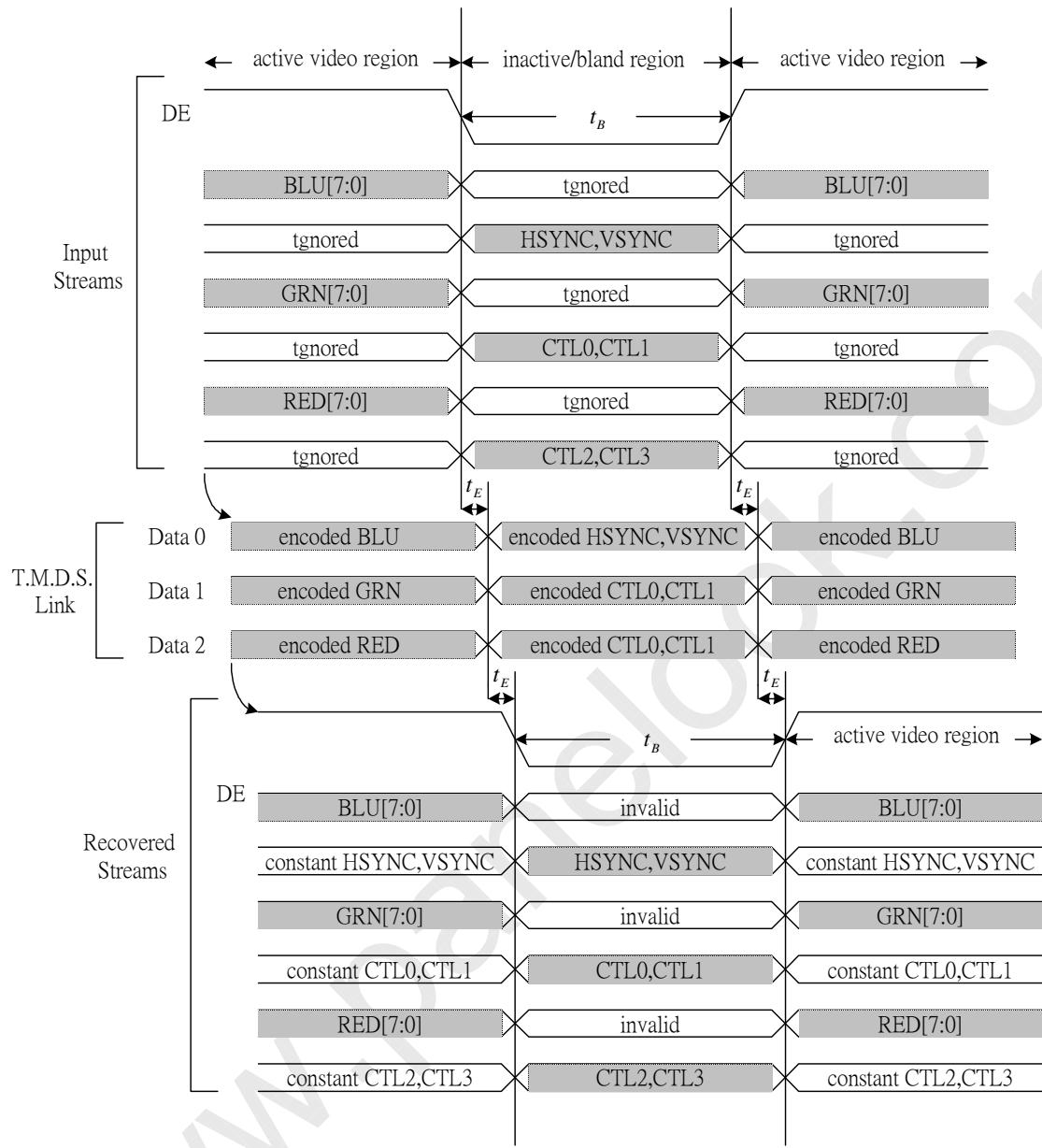
## 6.6 DVI SIGNAL LIST

| Signal Name             | Signal Description  | Note |
|-------------------------|---|------|
| T.M.D.S. Signals        |   |      |
| T.M.D.S. Clock + & -    | T.M.D.S. clock differential pair.   |      |
| T.M.D.S. Clock Shield   | Shield for T.M.D.S. clock differential pair.  |      |
| T.M.D.S. Data0 + & -    | T.M.D.S. link #0 channel #0 differential pair.  |      |
| T.M.D.S. Data0/5 Shield | Shared shield for T.M.D.S. link #0 channel #0 and link #1 channel #2.   |      |
| T.M.D.S. Data1 + & -    | T.M.D.S. link #0 channel #1 differential pair.  |      |
| T.M.D.S. Data2/4 Shield | Shared shield for T.M.D.S. link #0 channel #2 and link #1 channel #1.   |      |
| T.M.D.S. Data2 + & -    | T.M.D.S. link #0 channel #2 differential pair.  |      |
| T.M.D.S. Data1/3 Shield | Shared shield for T.M.D.S. link #0 channel #1 and link #1 channel #0.   |      |
| T.M.D.S. Data3 + & -    | T.M.D.S. link #1 channel #0 differential pair.  | (1)  |
| T.M.D.S. Data4 + & -    | T.M.D.S. link #1 channel #1 differential pair.  |      |
| T.M.D.S. Data5 + & -    | T.M.D.S. link #1 channel #2 differential pair.  |      |
| Control Signals         |   |      |
| Hot Plug Detect(HPD)    | Signal is driven by monitor to enable the system to identify the presence of a monitor.                                     |      |
| DDC Data                | The data line for the DDC interface.  |      |
| DDC Clock               | The clock line for the DDC interface  |      |
| +5V Power               | +5 volt signal provided by the system to enable the monitor to provide EDID data when the monitor circuitry is not powered. |      |
| Ground (for +5V)        | Ground reference for +5 volt power pin. Used as return by Hsync and Vsync Signals.  |      |
| Analog Signals          |   |      |
| Analog Red              | Analog Red signal.  | (1)  |
| Analog Green            | Analog Green signal.  |      |
| Analog Blue             | Analog Blue signal.   |      |
| Analog Horizontal Sync  | Horizontal synchronization signal for the analog interface.   |      |
| Analog Vertical Sync    | Vertical synchronization signal for the analog interface.   |      |
| Analog Ground           | Common ground for analog signals. Used as a return for analog red, green and blue signals only.                             |      |

Note (1) No using.

(2)The DVI signal list is specified in the DVI specification of DDWG

## 6.7 DVI LINK TIMING REQUIREMENTS



| Symbol | Description  | Value | Unit        |
|--------|--|-------|-------------|
| $t_B$  | Minimum duration blanking period required to ensure character boundary recovery at the receiver. Blanking periods of this duration must occur at least once every 50mS (20Hz). | 128   | $T_{pixel}$ |
| $t_E$  | Maximum encoding/serializer pipeline delay.  | 64    | $T_{pixel}$ |
| $t_R$  | Maximum recovery/de-serializer pipeline delay. Recovery timing includes inter-channel skew, and is measured from the earliest DE transition among the data channels.           | 64    | $T_{pixel}$ |

Note: The DVI link timing requirements are specified in the DVI specification of DDWG.

## 7. INTERFACE TIMING

### 7.1 INPUT SIGNAL TIMING SPECIFICATIONS

The input signal timing specifications are shown as the following table and timing diagram.

| Signal  | Item       | Symbol | Min. | Typ. | Max. | Unit | Note       |
|---|------------|--------|------|------|------|------|------------|
| DVI Receiver Clock (Single DVI)                                       | Frequency  | 1/Tc   | 120  | 144  | 152  | MHz  | (2)        |
| Vertical Active Display Term<br>(Single DVI, 1920x1080 Active Area)   | Frame Rate | Fr5    | 47   | 50   | 53   | Hz   | (3)        |
|   |            | Fr6    | 57   | 60   | 63   | Hz   | (4) (5)    |
|   | Total      | Tv     | 1082 | 1090 | 1150 | Th   | Tv=Tvd+Tvb |
| Horizontal Active Display Term<br>(Single DVI, 1920x1080 Active Area) | Display    | Tvd    | -    | 1080 | -    | Th   |            |
|   | Blank      | Tvb    | 2    | 10   | 70   | Th   |            |
|   | Total      | Th     | 2190 | 2200 | 2350 | Tc   | Th=Thd+Thb |
| Display   | Thd        | -      | 1920 | -    | -    | Tc   |            |
|   | Blank      | Thb    | 270  | 280  | 430  | Tc   |            |

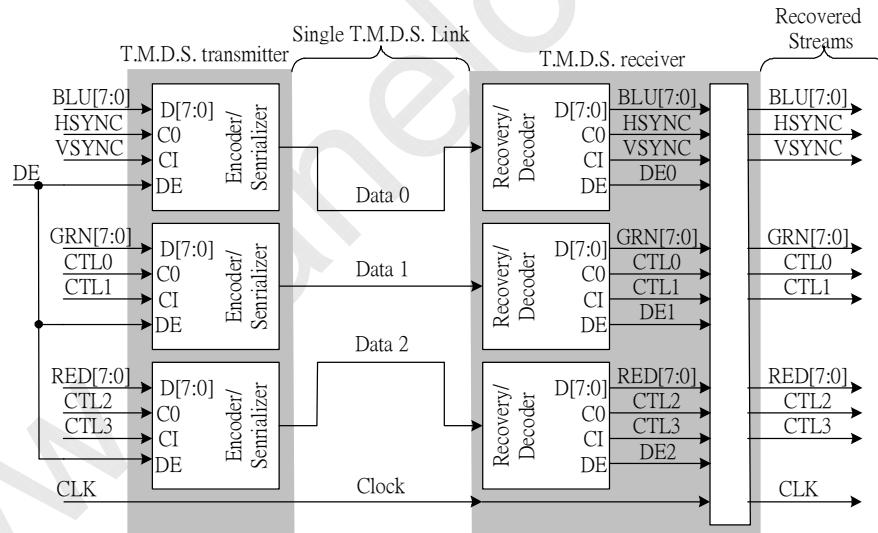
Note: (1) Since this module is operated in DE only mode, Hsync and Vsync input signals should be set to low logic level. Otherwise, this module would operate abnormally.

(2) The value of Typ. is based on 60Hz operation.

(3) (ODSEL) = (H). Please refer to Section 6.2 for detail information.

(4) (ODSEL) = (L). Please refer to Section 6.2 for detail information.

(5) The value of Max. will be modified beyond 60 Hz in the future due to the improvement from design.



Note: The single link T.M.D.S. channel map is specified in the DVI specification of DDWG


**7.2 EXTENDED DISPLAY IDENTIFICATION DATA (EDID) STRUCTURE**

| Address    | No. bytes |              | Description                              | Address    | No. bytes |              | Description   |
|------------|-----------|--------------|--|------------|-----------|--------------|---|
| <b>00h</b> | <b>8</b>  | <b>Bytes</b> | <b>Header</b>                            | 1Ch        |           | 1            | Red -y  |
| 00h        |           | 1            | 00h                                      | 1Dh        |           | 1            | Green -x  |
| 01h        |           | 1            | FFh                                      | 1Eh        |           | 1            | Green -y  |
| 02h        |           | 1            | FFh                                      | 1Fh        |           | 1            | Blue -x   |
| 03h        |           | 1            | FFh                                      | 20h        |           | 1            | Blue -y   |
| 04h        |           | 1            | FFh                                      | 21h        |           | 1            | White -x  |
| 05h        |           | 1            | FFh                                      | 22h        |           | 1            | White -y  |
| 06h        |           | 1            | FFh                                      | <b>23h</b> | <b>3</b>  | <b>Bytes</b> | <b>Established Timings</b>                            |
| 07h        |           | 1            | 00h                                      | 23h        |           | 1            | Established Timings 1                                 |
| <b>08h</b> | <b>10</b> | <b>Bytes</b> | <b>Vender/Product Identification</b>     | 24h        |           | 1            | Established Timings 2                                 |
| 08h        |           | 2            | ID Manufacturer Name                     | 25h        |           | 1            | Manufacturers Reserved Timings                        |
| 0Ah        |           | 2            | ID Product Code                          | <b>26h</b> | <b>16</b> | <b>Bytes</b> | <b>Standard Timing Identification</b>                 |
| 0Ch        |           | 4            | ID Serial Number                         | 26h        |           | 2            | Standard Timing Identification #1                     |
| 10h        |           | 1            | Week of Manufacture                      | 28h        |           | 2            | Standard Timing Identification #2                     |
| 11h        |           | 1            | Year of Manufacture                      | 2Ah        |           | 2            | Standard Timing Identification #3                     |
| <b>12h</b> | <b>2</b>  | <b>Bytes</b> | <b>EDID Structure Version/Revision</b>   | 2Ch        |           | 2            | Standard Timing Identification #4                     |
| 12h        |           | 1            | Version #                                | 2Eh        |           | 2            | Standard Timing Identification #5                     |
| 13h        |           | 1            | Revision #                               | 30h        |           | 2            | Standard Timing Identification #6                     |
| <b>14h</b> | <b>5</b>  | <b>Bytes</b> | <b>Basic Display Parameters/Features</b> | 32h        |           | 2            | Standard Timing Identification #7                     |
| 14h        |           | 1            | Video Input Definition                   | 34h        |           | 2            | Standard Timing Identification #8                     |
| 15h        |           | 1            | Max.Horizontal Image Size                | <b>36h</b> | <b>72</b> | <b>Bytes</b> | <b>Detailed Timing Descriptions</b>                   |
| 16h        |           | 1            | Max.Vertical Image Size                  | 36h        |           | 18           | Detailed Timing Description #1 or Monitor Descriptor. |
| 17h        |           | 1            | Display Transfer Characteristic (Gamma)  | 48h        |           | 18           | Detailed Timing Description #2 or Monitor Descriptor. |
| 18h        |           | 1            | Feature Support                          | 5Ah        |           | 18           | Detailed Timing Description #3 or Monitor Descriptor. |
| <b>19h</b> | <b>10</b> | <b>Bytes</b> | <b>Color Characteristics</b>             | 6Ch        |           | 18           | Detailed Timing Description #4 or Monitor Descriptor. |
| 19h        |           | 1            | Red / Green Low Bits                     | <b>7Eh</b> | <b>1</b>  | <b>Byte</b>  | <b>Extension Flag</b>                                 |
| 1Ah        |           | 1            | Blue / White Low Bits                    | <b>7Fh</b> | <b>1</b>  | <b>Byte</b>  | <b>Checksum</b>                                       |
| 1Bh        |           | 1            | Red -x                                   |            |           |              |   |

Note: The EDID structure is specified in the EDID standard of VESA.



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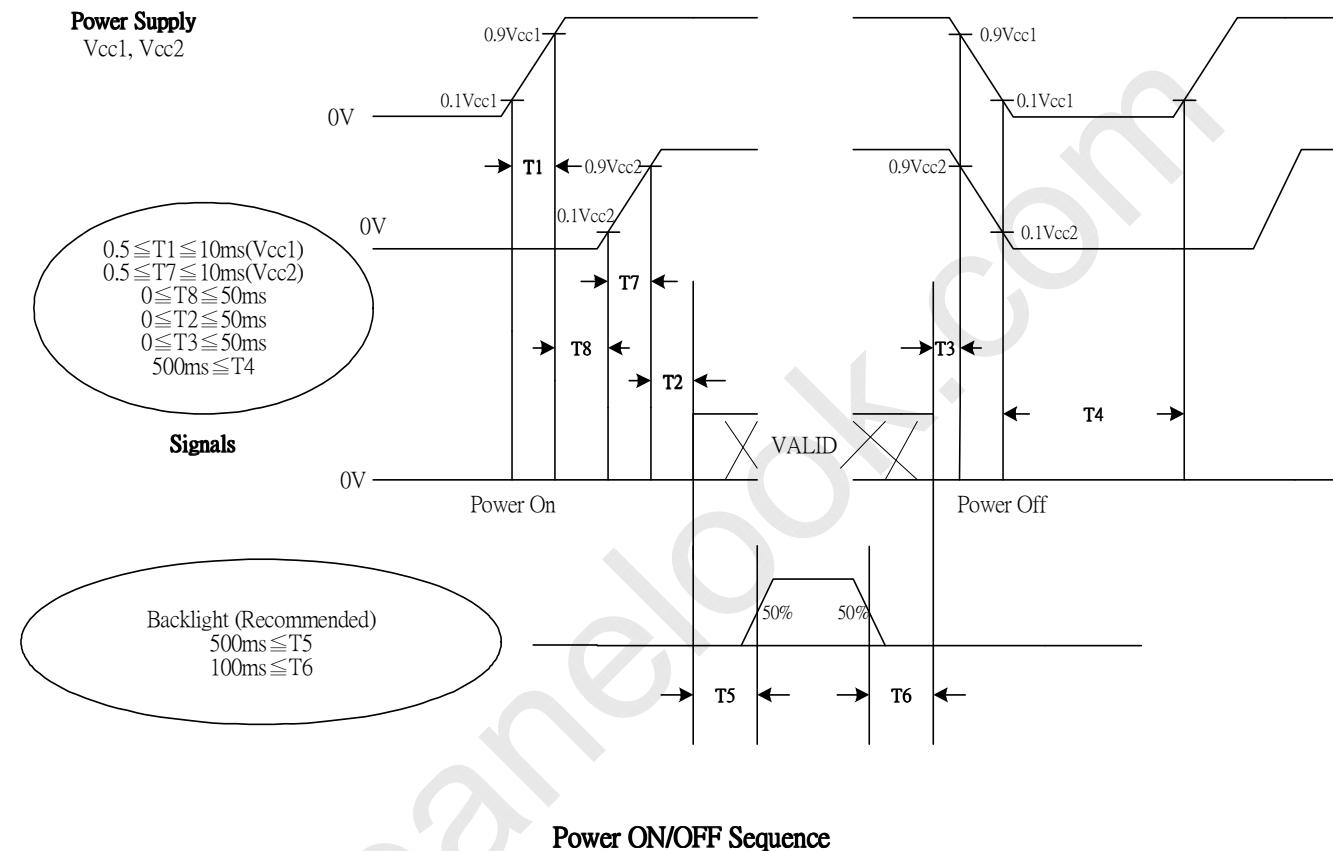
### 7.3 EXTENDED DISPLAY IDENTIFICATION DATA (EDID) CODE

| ADDR   | 0  | 1  | 2  | 3  | 4  | 5  | 6  | 7 - 8   | 9  | A  | B  | C  | D  | E  | F  |
|--------|----|----|----|----|----|----|----|---------|----|----|----|----|----|----|----|
| 000000 | 00 | FF | FF | FF | FF | FF | FF | 00 - 3A | C4 | 10 | A0 | 64 | 00 | 00 | 00 |
| 000010 | 31 | 0F | 01 | 03 | 80 | 34 | 21 | 78 - EE | EE | 50 | A3 | 54 | 4C | 9B | 26 |
| 000020 | 0F | 50 | 54 | 00 | 00 | 00 | 01 | 01 - 01 | 01 | 01 | 01 | 01 | 01 | 01 | 01 |
| 000030 | 01 | 01 | 01 | 01 | 01 | 01 | 34 | 38 - 80 | 18 | 71 | 38 | 0A | 40 | 10 | 50 |
| 000040 | 12 | 00 | 54 | 30 | 34 | 00 | 00 | 18 - D6 | 2E | 80 | 18 | 71 | 38 | 0A | 40 |
| 000050 | 10 | 50 | 12 | 00 | 54 | 30 | 34 | 00 - 00 | 18 | F6 | 2C | 80 | 18 | 71 | 77 |
| 000060 | 0A | 40 | 10 | 50 | 12 | 00 | 54 | 30 - 34 | 00 | 00 | 18 | 00 | 00 | 00 | 00 |
| 000070 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 - 00 | 00 | 00 | 00 | 00 | 00 | 00 | 38 |

Note:(1) The EDID code implies 60Hz, 50Hz and 48Hz.

## 7.4 POWER ON/OFF SEQUENCE

To prevent a latch-up or DC operation of LCD module, the power on/off sequence should be followed as the diagram below.



Note : (1) The supplied voltage of the external system for the module input should follow the definition of Vcc1,2.

(2) Apply the lamp voltage within the LCD operation range. When the backlight turns on before the LCD operation or the LCD turns off before the backlight turns off, the display may momentarily become abnormal screen.

(3) In case of Vcc1,2 is in off level, please keep the level of input signals on the low and avoid floating.

(4) T4 should be measured after the module being fully discharged between power off and on period.

(5) Interface signal shall not be kept at high impedance when the power is on.



## 8. OPTICAL CHARACTERISTICS

### 8.1 TEST CONDITIONS

| Item                             | Symbol          | Value   | Unit |
|----------------------------------|-----------------|---|------|
| Ambient Temperature              | T <sub>a</sub>  | 25±2  | °C   |
| Ambient Humidity                 | H <sub>a</sub>  | 50±10   | %RH  |
| Supply Voltage                   | V <sub>CC</sub> | 5.0   | V    |
| Input Signal                     |                 | According to typical value in "3. ELECTRICAL CHARACTERISTICS" |      |
| Lamp Current                     | I <sub>L</sub>  | 6.0±0.5   | mA   |
| Oscillating Frequency (Inverter) | F <sub>L</sub>  | 50±3  | KHz  |
| Frame Rate                       | F <sub>r</sub>  | 60  | Hz   |

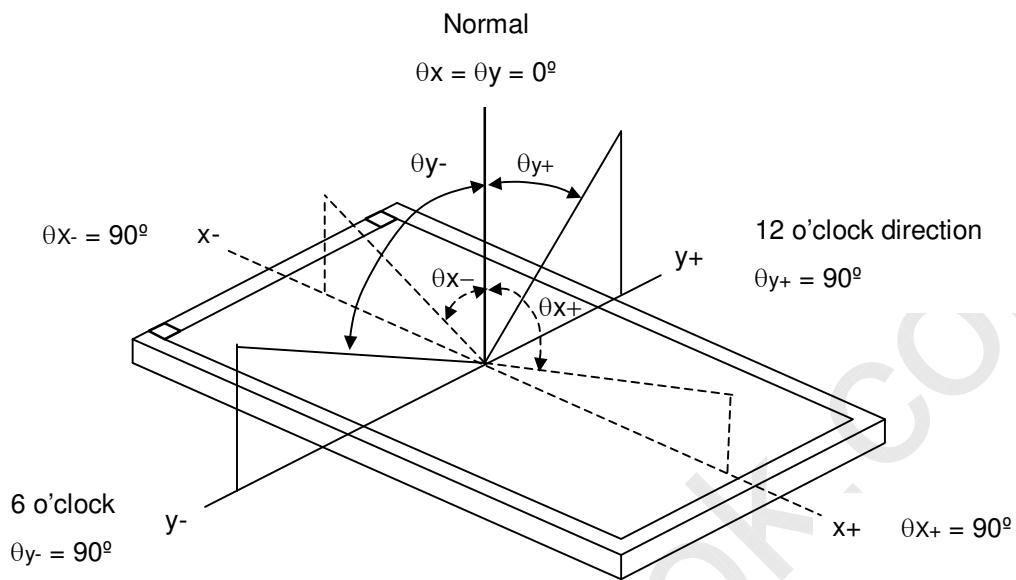
### 8.2 OPTICAL SPECIFICATIONS

The relative measurement methods of optical characteristics are shown in 8.2 Notes. The following items should be measured under the test conditions described in 8.1 and stable environment shown in Note (6).

| Item                       | Symbol           | Condition   | Min.  | Typ.  | Max. | Unit              | Note          |  |  |
|----------------------------|------------------|---|-------|-------|------|-------------------|---------------|--|--|
| Contrast Ratio             | CR               |   | 900   | 1200  |      | -                 | Note (2)      |  |  |
| Response Time              | Gray to gray     |   |       | 6.5   |      | ms                | Note (3)      |  |  |
| Center Luminance of White  | L <sub>C</sub>   |   | 400   | 450   |      | cd/m <sup>2</sup> | Note (4)      |  |  |
| Average Luminance of White | L <sub>AVE</sub> |   | 400   | 450   |      | cd/m <sup>2</sup> | Note (4)      |  |  |
| White Variation            | δW               |   |       |       | 1.6  | -                 | Note (7)      |  |  |
| Cross Talk                 | CT               |   |       |       | 2    | %                 | Note (5)      |  |  |
| Color Chromaticity         | Red              | θ <sub>x</sub> =0°, θ <sub>y</sub> =0°<br>Viewing angle at normal direction | Typ.  | 0.651 |      | -                 | Note (6)      |  |  |
|                            |                  |   |       | 0.332 |      | -                 |               |  |  |
|                            | Green            |   |       | 0.269 |      | -                 |               |  |  |
|                            |                  |   |       | 0.593 |      | -                 |               |  |  |
|                            | Blue             |   | -0.03 | 0.144 |      | -                 |               |  |  |
|                            |                  |   |       | 0.060 |      | -                 |               |  |  |
|                            | White            |   |       | 0.285 |      | -                 |               |  |  |
|                            |                  |   |       | 0.293 |      | -                 |               |  |  |
|                            | Color Gamut      | C.G   |       | 72    | 75   | %                 | NTSC          |  |  |
| Viewing Angle              | Horizontal       | CR≥30   |       | 80    | 88   |                   | Deg. Note (1) |  |  |
|                            |                  |   |       | 80    | 88   |                   |               |  |  |
|                            | Vertical         |   |       | 80    | 88   |                   |               |  |  |
|                            |                  |   |       | 80    | 88   |                   |               |  |  |

Note (1) Definition of Viewing Angle ( $\theta_x, \theta_y$ ):

Viewing angles are measured by Eldim EZ-Contrast 160R



Note (2) Definition of Contrast Ratio (CR):

The contrast ratio can be calculated by the following expression.

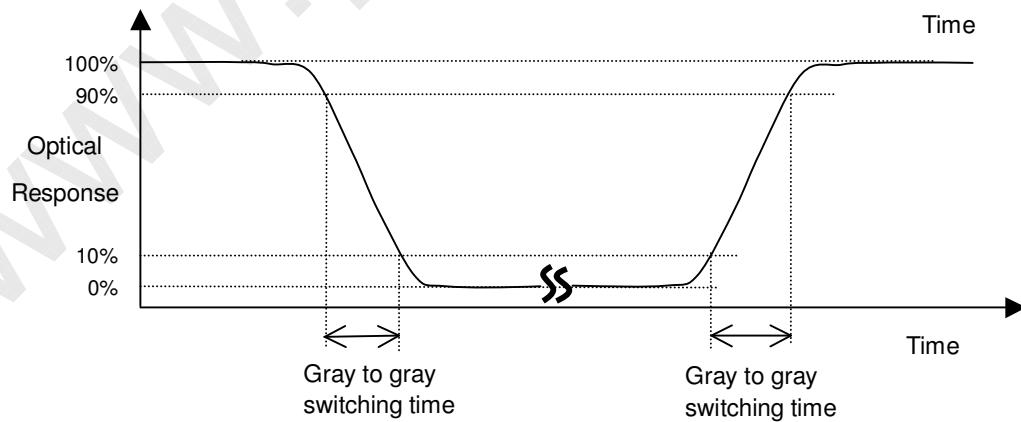
$$\text{Contrast Ratio (CR)} = L_{255} / L_0$$

$L_{255}$ : Luminance of gray level 255

$L_0$ : Luminance of gray level 0

$CR = CR (7)$ , where  $CR (X)$  is corresponding to the Contrast Ratio of the point X at the figure in Note (7).

Note (3) Definition of Gray to Gray Switching Time:



The driving signal means the signal of gray level 0, 63, 127, 191, 255.

Gray to gray average time means the average switching time of gray level 0, 63, 127, 191, 255 to each other.



Note (4) Definition of Luminance of White ( $L_C$ ,  $L_{AVE}$ ):

Measure the luminance of gray level 255 at center point and 5 points

$$L_C = L(7)$$

$$L_{AVE} = [L(4) + L(5) + L(7) + L(9) + L(10)] / 5$$

Where  $L(x)$  is corresponding to the luminance of the point X at the figure in Note (7).

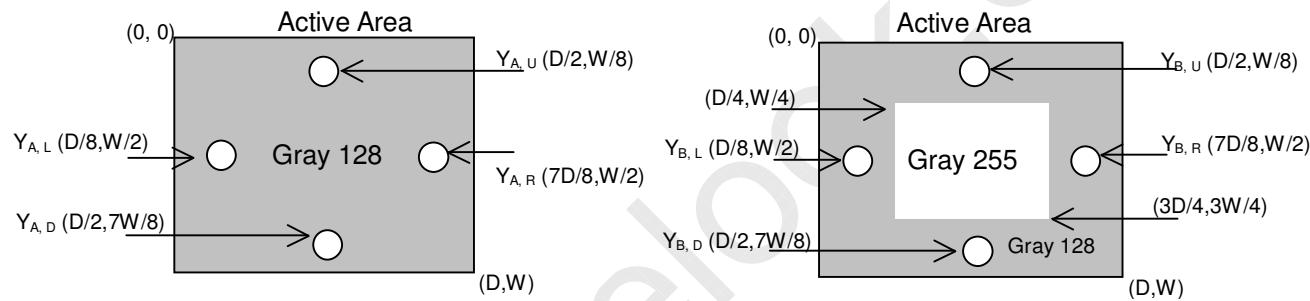
Note (5) Definition of Cross Talk (CT):

$$CT = |Y_B - Y_A| / Y_A \times 100 (\%)$$

Where:

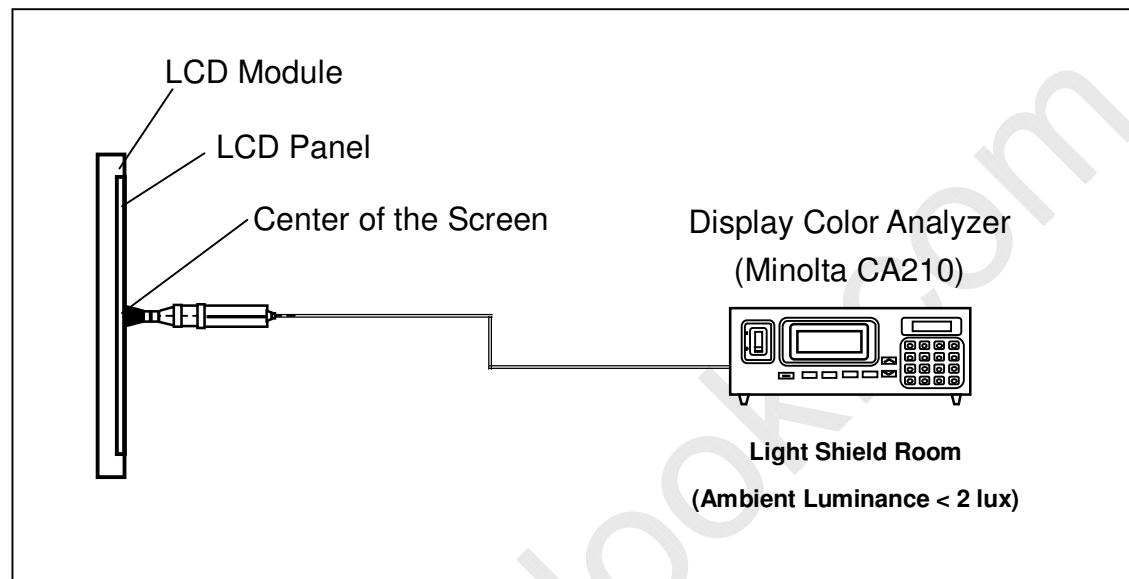
$Y_A$  = Luminance of measured location without gray level 255 pattern ( $cd/m^2$ )

$Y_B$  = Luminance of measured location with gray level 255 pattern ( $cd/m^2$ )



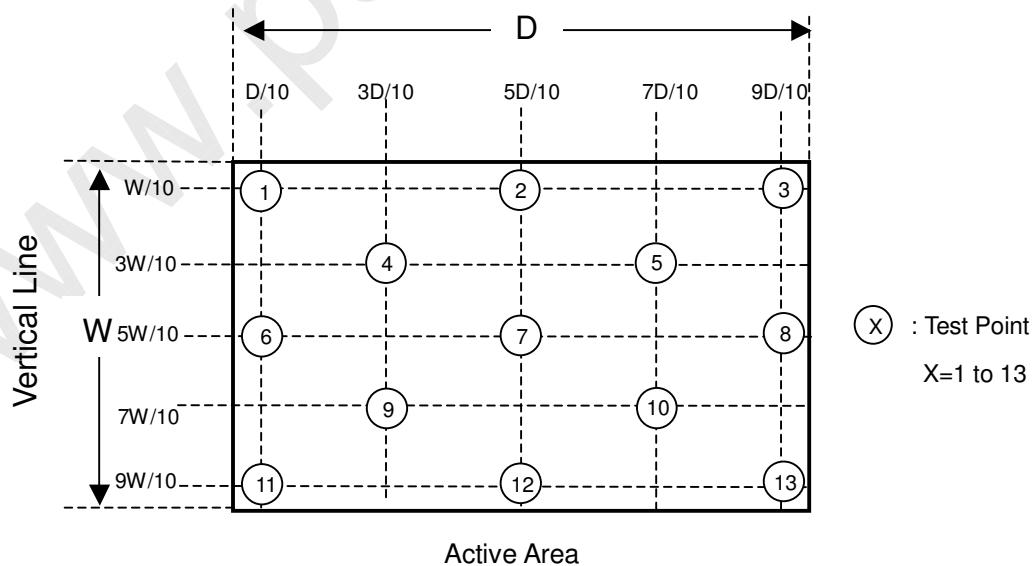
**Note (6) Measurement Setup:**

The LCD module should be stabilized at given temperature for 1 hour to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting backlight for 1 hour in a windless room.


**Note (7) Definition of White Variation ( $\delta W$ ):**

Measure the luminance of gray level 128 at 13 points

$$\delta W = \text{Maximum} [L(1), L(2), L(3), L(4), \dots, L(13)] / \text{Minimum} [L(1), L(2), L(3), L(4), \dots, L(13)]$$





## 9. PRECAUTIONS

### 9.1 ASSEMBLY AND HANDLING PRECAUTIONS

- (1) Do not apply rough force such as bending or twisting to the module during assembly.
- (2) It is recommended to assemble or to install a module into the user's system in clean working areas. The dust and oil may cause electrical short or worsen the polarizer.
- (3) Do not apply pressure or impulse to the module to prevent the damage of LCD panel and Backlight.
- (4) Always follow the correct power-on sequence when the LCD module is turned on. This can prevent the damage and latch-up of the CMOS LSI chips.
- (5) Do not plug in or pull out the I/F connector while the module is in operation.
- (6) Do not disassemble the module.
- (7) Use a soft dry cloth without chemicals for cleaning, because the surface of polarizer is very soft and easily scratched.
- (8) Moisture can easily penetrate into LCD module and may cause the damage during operation.
- (9) When storing modules as spares for a long time, the following precaution is necessary.
  - a. Do not leave the module in high temperature, and high humidity for a long time. It is highly recommended to store the module with temperature from 0 to 35°C at normal humidity without condensation.
  - b. The module shall be stored in dark place. Do not store the TFT-LCD module in direct sunlight or fluorescent light.
- (10) When ambient temperature is lower than 10°C, the display quality might be reduced. For example, the response time will become slow, and the starting voltage of CCFL will be higher than that of room temperature.

### 9.2 SAFETY PRECAUTIONS

- (1) The startup voltage of a Backlight is approximately 1000 Volts. It may cause an electrical shock while assembling with the inverter. Do not disassemble the module or insert anything into the Backlight unit.
- (2) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, skin or clothes, it has to be washed away thoroughly with soap.
- (3) After the module's end of life, it is not harmful in case of normal operation and storage.

### 9.3 SAFETY STANDARDS

The LCD module should be certified with safety regulations as follows:

- (1) UL60950-1 or updated standard.
- (2) IEC60950-1 or updated standard.
- (3) UL60065 or updated standard.
- (4) IEC60065 or updated standard.



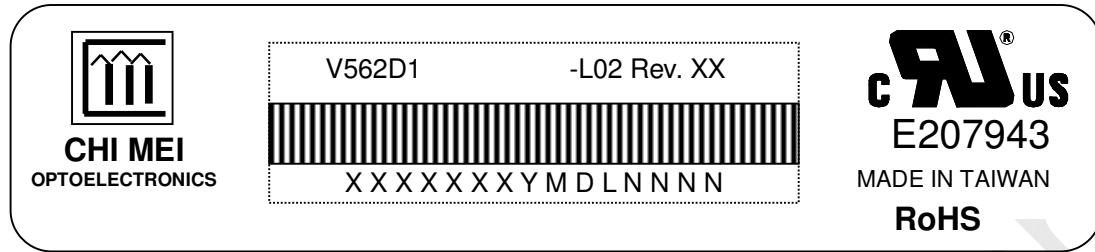
Issued Date: Sep. 25, 2007  
Model No.: V562D1-L02

Approval

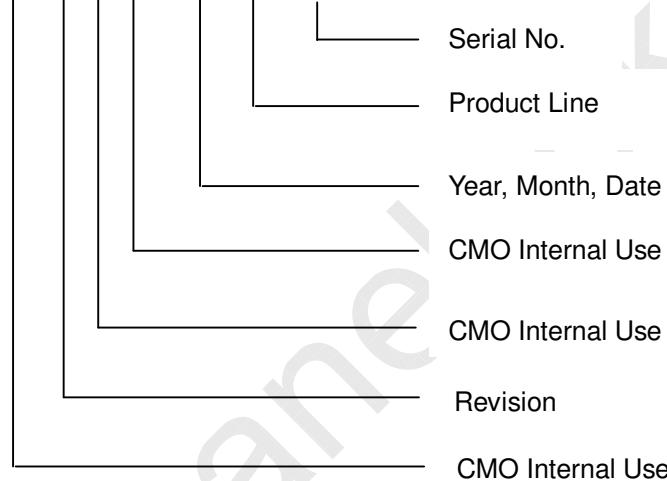
## 10. DEFINITION OF LABELS

### 10.1 CMO MODULE LABEL

The barcode nameplate is pasted on each module as illustration, and its definitions are as following explanation.



- (a) Model Name: V562D1-L02
- (b) Revision: Rev. XX, for example: A0, A1... B1, B2... or C1, C2...etc.
- (c) Serial ID: XXXXXXYMDLNNN



Serial ID includes the information as below:

- (a) Manufactured Date: Year: 0~9, for 2000~2009  
Month: 1~9, A~C, for Jan. ~ Dec.  
Day: 1~9, A~Y, for 1<sup>st</sup> to 31<sup>st</sup>, exclude I, O, and U.
- (b) Revision Code: Cover all the change
- (c) Serial No.: Manufacturing sequence of product
- (d) Product Line: 1 -> Line1, 2 -> Line 2, ...etc.

## 11. PACKAGE

### 11.1 PACKING SPECIFICATIONS

- (1) 2 LCD TV modules / 1 Box
- (2) Box dimensions : 1448(L) X 372 (W) X 901 (H)
- (3) Weight : approximately 56Kg (2 modules per box)
- (4) One protective film is attached on the LCD TV

### 11.2 PACKING METHOD

Figures 9-1 and 9-2 are the packing method

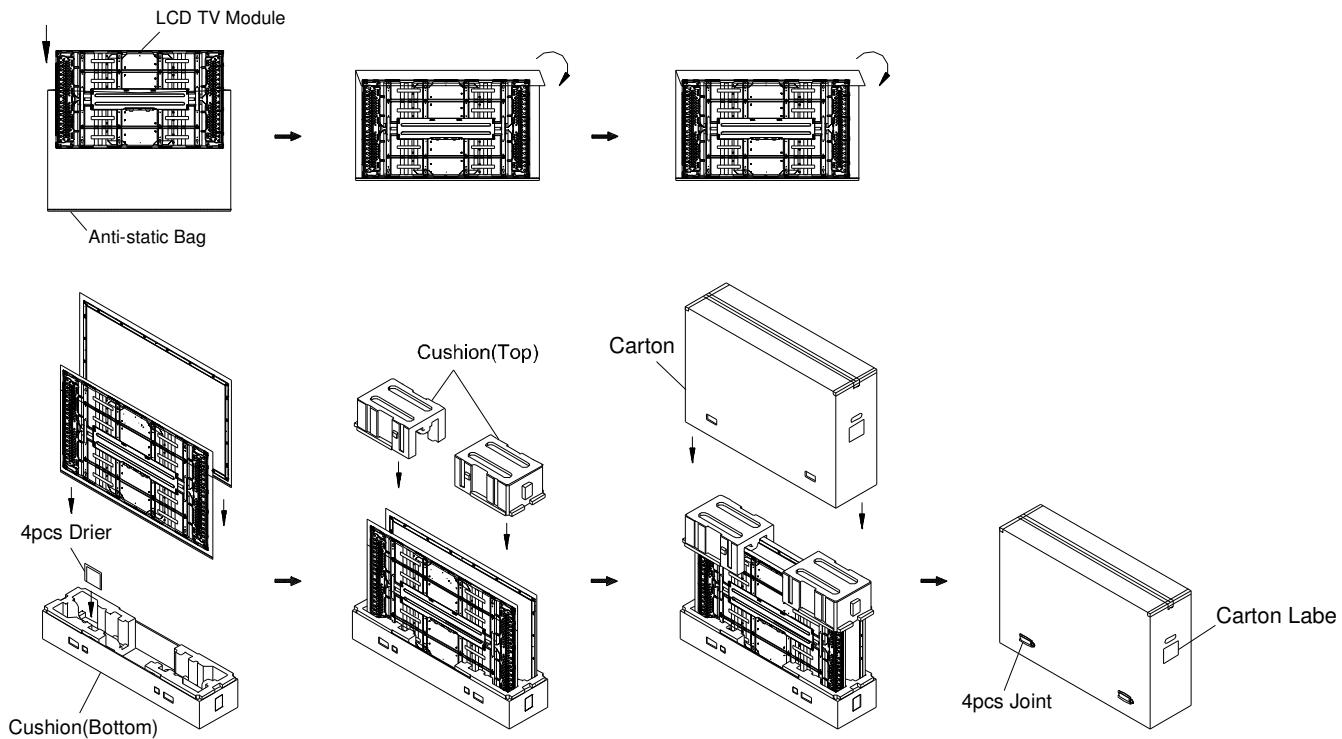
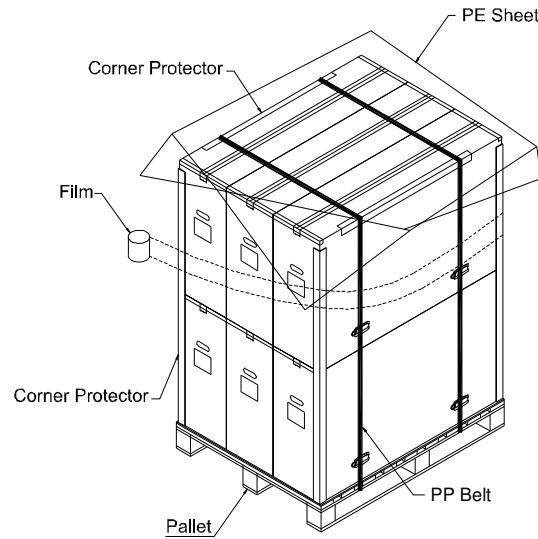


Figure.9-1 packing method

**Sea Transportation**

Corner Protector:L1780\*50mm\*50mm  
Corner Protector:L1130\*50mm\*50mm  
Pallet:L1150\*W1460\*H140mm  
Pallet Stack:L1150\*W1460\*H1942mm  
Gross:353kg

**Air Transportation**

Corner Protector:L800\*50mm\*50mm  
Corner Protector:L1130\*50mm\*50mm  
Pallet:L1150\*W1460\*H140mm  
Pallet Stack:L1150\*W1460\*H1041mm  
Gross:185kg

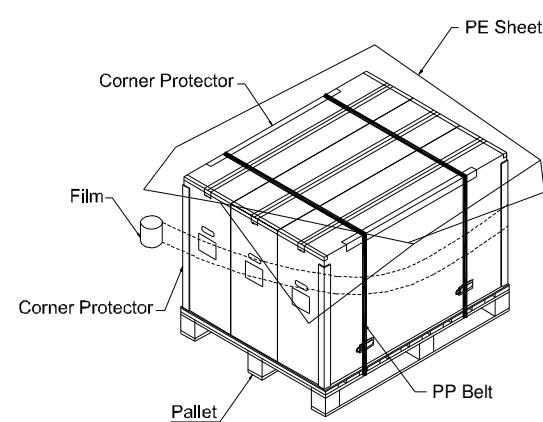
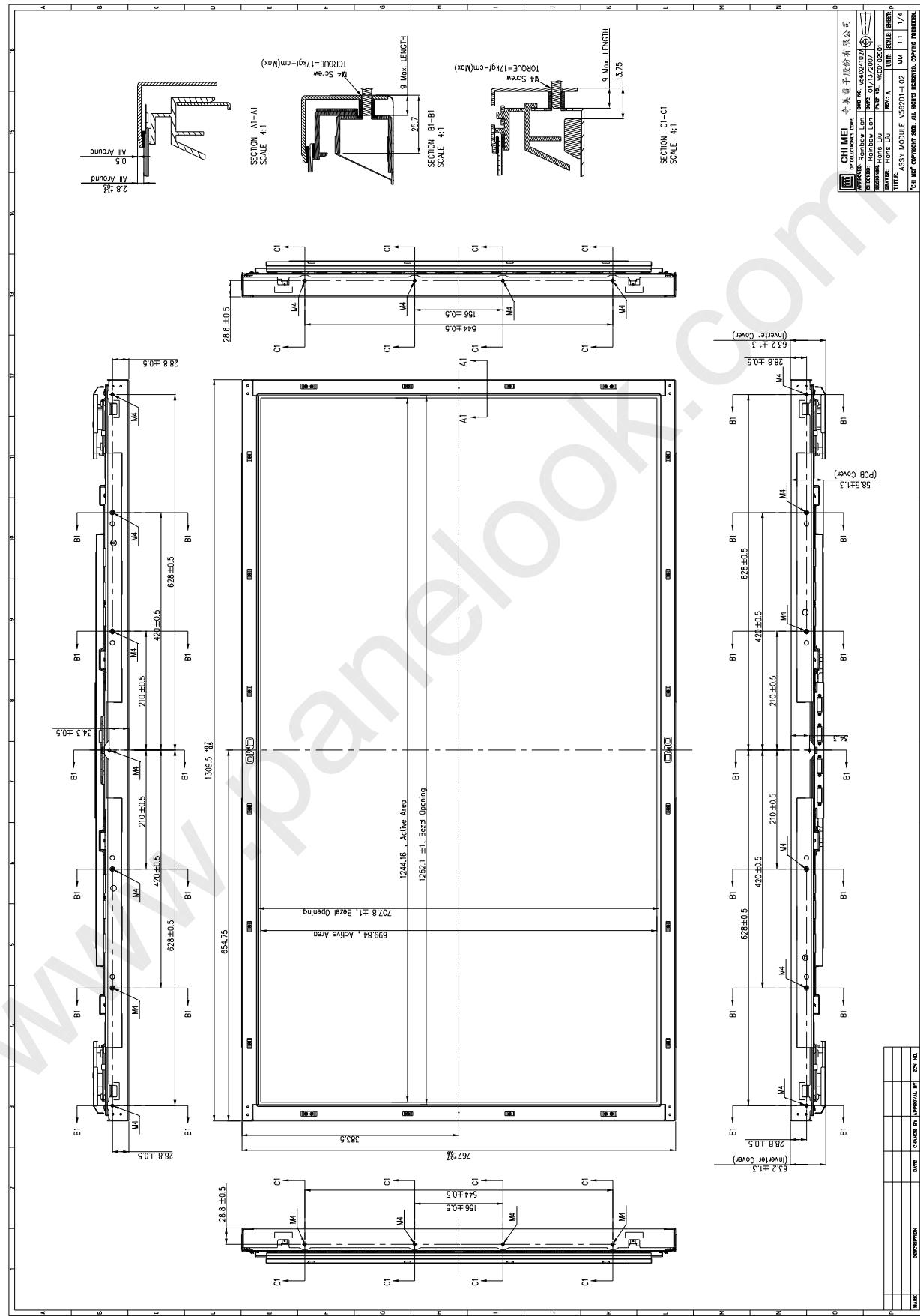


Figure. 9-2 Packing method

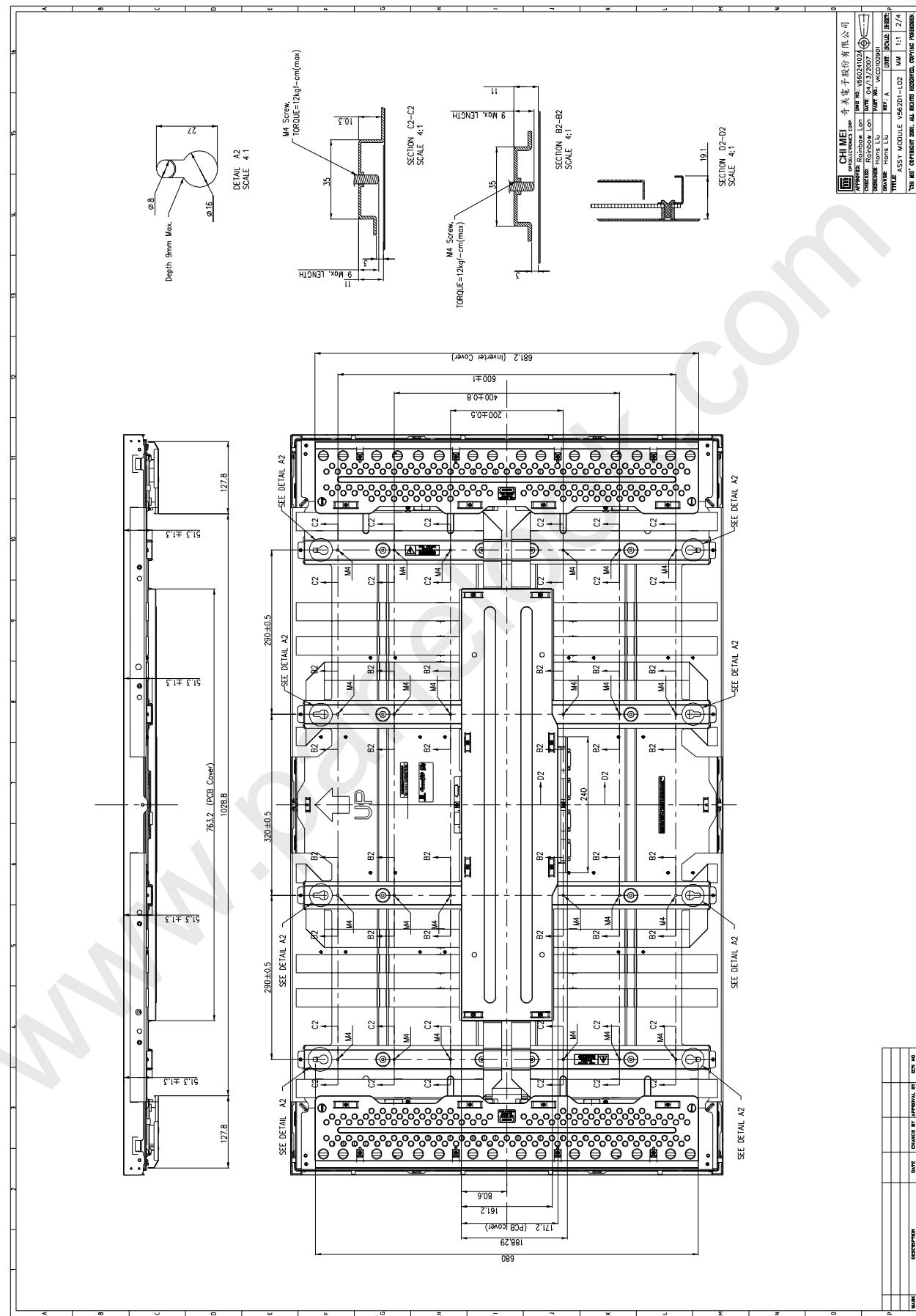
## 12. MECHANICAL CHARACTERISTIC

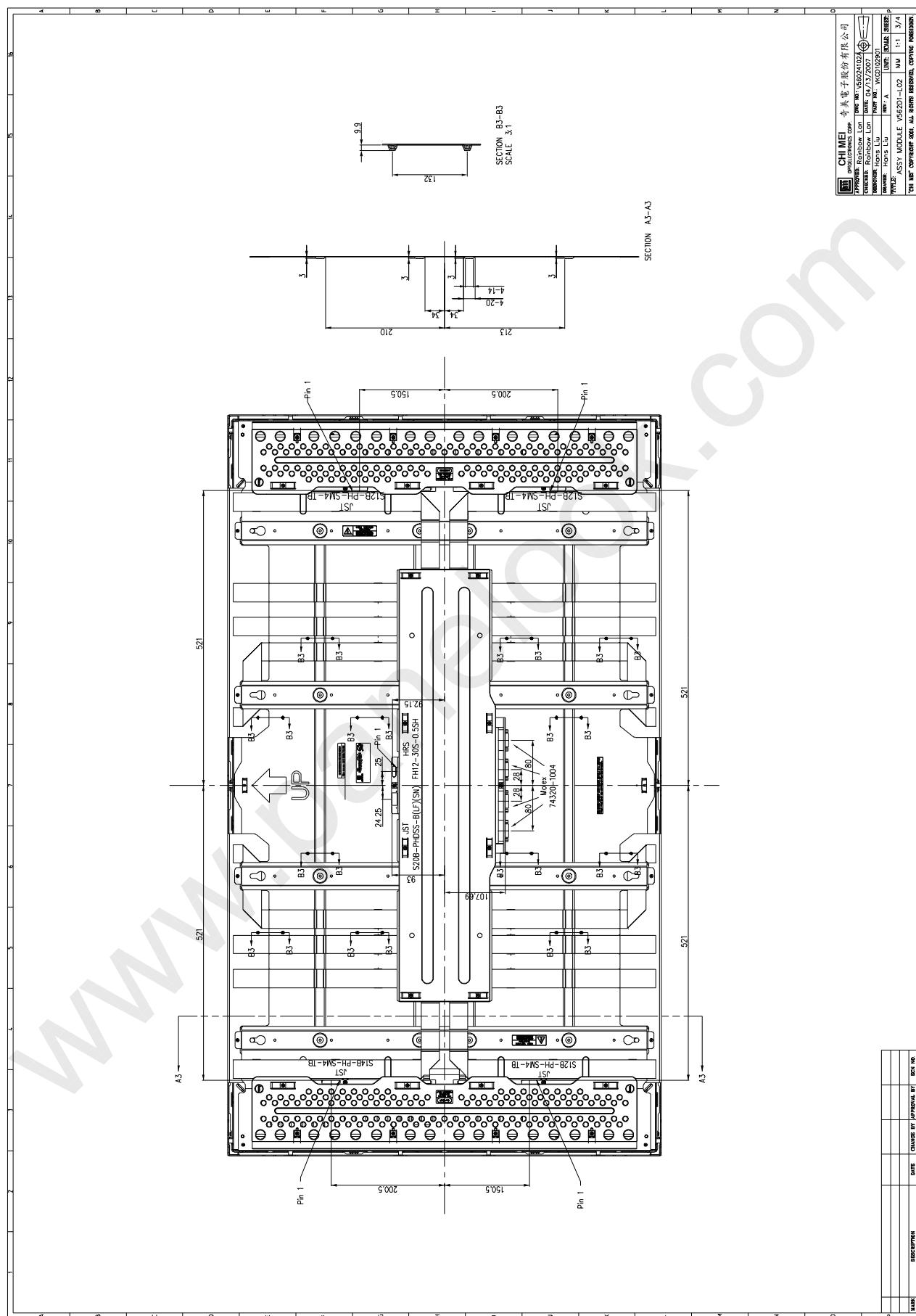




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